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NAVAL POSTGRADUATE SCHOOL
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THESIS

IMPROVING HOSPITAL PRODUCTIVITY: AN ANALYSIS OF THE CONTRIBUTION OF ADMINISTRATIVE/CLERICAL STAFF TO PHYSICIAN PRODUCTIVITY

by

Cynthia A. Nixon

June 1993

Thesis Advisor: Ronald Weitzman
Thesis Co-Advisor: Kenneth Orloff

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12 Personal Author(s) Cynthia A. Nixon

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During the mid 1980s, Navy medicine was under constant criticism by its users, and members of Cogress. Between FY85 and FY88, the number of outpatient visits decline 21 percent within Navy Medical Treatment Facilities (MTFs), while CHAMPUS outpatient visits increased 78 percent. During this same period, fleet operational assignments tripled and other programs were implemented that reduced Navy's ability to provide patient care in the U.S. In addition, between fiscal years 1980 through 1988, physician retention rates within Navy declined to 43 percent, lower than the rates for Army and Air Force. According to the GAO, one of the chief compaints of all military physicians is inadequate levels of administrative/clerical support. Thus, it has become increasingly important that Navy manpower requirements be determined with increased accuracy to maximize MTF productivity. This study uses regression analysis to evaluate the functional relationship between administrative staff mix and physician productivity across similar hospitals, focusing on workcenters in the primary care areas, where the need is greatest. Data used in this suty is from the Medical Expense and Performance Reporting System (MEPRS). Unfortunately, when comparing hospitals the data appear to be inadequate for demonstrating a relationship between administrative/clerical staffing and physician productivity, although when comparing workcenters the results appear more promising.

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Improving Hospital Productivity: An Analysis of the Contribution
of Administrative/Clerical Staff to Physician Productivity

by

Cynthia A. Nixon
Lieutenant, Medical Service Corps, United States Navy Reserve
B.S., Florida Agricultural and Mechanical University, 1987

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

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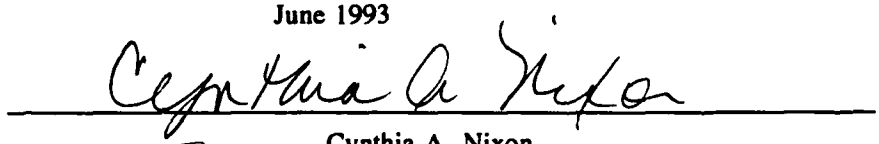
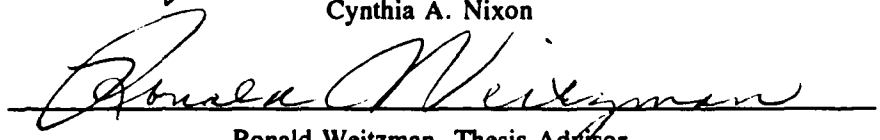
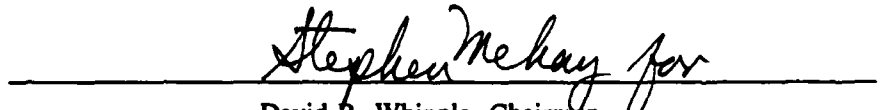
Author: 

Cynthia A. Nixon

Approved by: 

Ronald Weitzman, Thesis Advisor

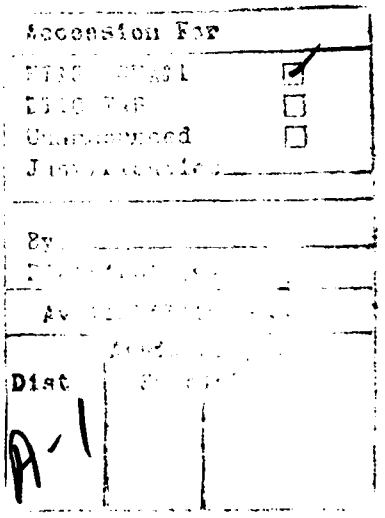
Kenneth Orloff, Thesis Co-Advisor



David R. Whipple, Chairman
Department of Administrative Sciences

ABSTRACT

During the mid 1980s, Navy medicine was under constant criticism by its users, its providers, and members of Congress. Between FY85 and FY88, the number of outpatient visits declined 21 percent within Navy Medical Treatment Facilities (MTFs), while CHAMPUS outpatient visits increased 78 percent. During this same period, fleet operational assignments tripled and other programs were implemented that reduced Navy's ability to provide patient care in the U.S. In addition, between fiscal years 1980 through 1988, physician retention rates within Navy declined to 43 percent, lower than the rates for Army and Air Force. According to the GAO, one of the chief complaints of all military physicians is inadequate levels of administrative/clerical support. Thus, it has become increasingly important that Navy manpower requirements be determined with increased accuracy to maximize MTF productivity. This study uses regression analysis to evaluate the functional relationship between administrative staff mix and physician productivity across similar hospitals, focusing on workcenters in the primary care areas, where the need is greatest. Data used in this study is from the Medical Expense and Reporting System (MEPRS). Unfortunately, when comparing hospitals the data appear to be inadequate for demonstrating a relationship between administrative/clerical staffing and physician productivity, although when comparing workcenters the results appear more promising.



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I. INTRODUCTION

A. BACKGROUND

During the mid 1980s, Navy medicine was under constant criticism by its users, providers and members of Congress. Its ability to meet wartime requirements and peacetime demand continually declined while Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) costs were rapidly rising. Users felt they were not receiving quality care [Ref. 1], while physicians were frustrated with the lack of diversity in case mix and increasing administrative burdens. In fiscal year (FY) 1990, the Navy provided medical care to a beneficiary population of around 1.8 million at an annual cost of over $992 million [Ref. 2]. During the period FY 1985 through FY 1988, the number of "direct care" outpatient visits declined 21 percent while CHAMPUS outpatient visits increased 78 percent. In addition, Na· inpatient admissions declined 17 percent while CHAMPUS admi.sions increased by 42 percent [Ref. 3]. Concurrently, fleet operational assignments tripled from 1982 through 1987, and additional programs were implemented that all resulted in fewer resources available to provide care to the beneficiaries in the United States. For these and other reasons, in 1988 the Secretary of the Navy established a Navy Blue Ribbon Panel (BRP) to make recommendations to improve beneficiary access and reduce

CHAMPUS dependency by making Military Treatment Facilities (MTFs) more efficient. Another objective of the BRP was to improve Graduate Medical Education. [Ref. 4] Chaired by the Vice Chief of Naval Operations (VCNO), the BRP reported its findings and recommendations in November 1988. One recommendation, BRP (CO-13), which was approved by the Secretary of the Navy, was to define the administrative /clerical requirements to support direct patient care. Once defined, these resources were to be allocated to facilities demonstrating the most need. Further, increased productivity targets were to be established for each facility proportional to the administrative/clerical support received [Ref. 5]. In FY 1989, requirements were identified resulting in the authorization of an additional 329 clerical positions that same year and 27 positions during FY 1990. Ten MTFs were selected to receive these personnel. In October 1991, upon request of the Flag Level Working Committee (FLWC) (responsible for monitoring results of the BRP initiatives), a review of actual benefits derived from these additional billets was conducted by the Bureau of Medicine and Surgery (BUMED). [Ref. 6] Despite the noted improvements in workload, there is little indication, given the lack of quantitative data, that the workload increases were the direct result of these additional clerical assets or that productivity actually improved. In addition, during FY 1991 DoD imposed a civilian hiring freeze which prevented the

routine replacement of personnel. However, exception was granted to the medical community in the form of waivers, given the need for administrative/clerical support and other medical personnel. While the waivers allowed for routine personnel replacements, although unvalidated, higher personnel turnover was observed among the lower grade (GS-4/5) clerical workers as they became eligible for other positions within DoD. [Ref. 7]. Physicians still argue that their opportunity to provide patient care is diminished because of the administrative burden placed on them due to lack of administrative/clerical support. Retention rates remain low, particularly among certain wartime and peacetime specialties. Physician shortages resulting from lower retention reduce the MTFs' ability to maximize the utility of its personnel and facility resources.

B. PHYSICIAN ATTRITION

Between 1985 and 1988 the percentage of physicians leaving the military rose from 13.7 to 15.6 [Ref. 8]. Concerned, the Chairman, Subcommittee on Military Personnel and Compensation, House Committee on Armed Services, asked the Government Accounting Office (GAO) to determine why more physicians were leaving. Based on a survey of approximately 1,500 physicians the GAO reported that, in total, physicians who intended to leave ran parallel to historical attrition rates within DoD. In addition, "almost one half of the active

duty physicians indicated at least a 70 percent probability of leaving service when they became eligible and about two-thirds had a 50 percent chance of leaving" as shown in Table 1. [Ref. 9] Of particular note, Navy physicians were more likely to leave than Army and Air Force (except 70 percent or greater) and the likelihood of physicians leaving is greater during the initial obligation.

Table 1. PHYSICIANS PLANNING TO LEAVE THE MILITARY UPON COMPLETION OF THEIR OBLIGATION

Figures are percentages	Stated Probability of Leaving	
PHYSICIAN CATEGORY	70% or >	50% or >
Overall	47	62
Army	41	58
Navy	50	65
Air Force	52	63
Obstetricians/Gynecologists	60	74
Surgeons	51	67
Internal Medicine	46	64
Primary Care	42	56
Support Medicine	71	78
Initial Military Obligation	62	77
Beyond Initial Obligation	28	42

Source: GAO/HRD-90-1, Military Physicians' Views on Military Medicine, Mar 90 (highlight added)

After reviewing these factors, GAO concluded that the probability of leaving is primarily influenced by:

- time spent on non-physician tasks,
- disparity between military and civilian compensation, and
- lack of opportunity to practice in primary specialty.

GAO further concluded that attrition could be most effectively reduced by increasing compensation and reducing the amount of non-physician tasks performed [Ref. 10] In this report, non-physician tasks included work that should have been performed by clerks and/or technicians.

C. THE PROBLEM

As previously stated, MTF productivity has not been maximized, in part, due to the shortage of military physicians which results partly from a lack of adequate administrative/clerical support. The issue for Navy manpower planners remains determining the administrative/clerical requirements that will improve productivity within Navy MTFs. To examine this issue this thesis will look at the variation in the administrative/clerical staff among Navy hospitals compared to Army and Air Force hospitals.

D. RESEARCH OBJECTIVES

Of primary interest is determining the factors that explain the variation in administrative/clerical staffing patterns among Navy hospitals with similar characteristics and whether the same variation exists among the other branches of service. Secondary questions this thesis will address are:

1. Can the contribution of the administrative/clerical staff to productivity be determined for use in forecasting future staff requirements?

2. Does the Navy employ administrative/clerical personnel more or less efficiently than the Army and/or Air Force?

By understanding the relationship between the administrative/clerical complement and physician productivity, it may be possible to develop a model that forecasts future staff requirements. By accurately identifying and servicing clerical needs, physician productivity can be maximized, allowing them to see more patients without negative impact on the quality of care. Improvement in physician productivity implies improvement in hospital productivity, holding all other factors constant.

E. SCOPE

This thesis will use regression analysis to evaluate the functional relationship between administrative staff mix and physician productivity across similar hospitals, focusing on work centers where the need for physicians is greatest. Since data is not yet available for FY 1992 and results using FY 1991 data may be skewed due to Operation Desert Storm, the analysis will be conducted using data from FY 1990. Workload and performance data will be obtained from the Medical Expense and Performance Reporting System (MEPRS) as obtained via direct link to the Defense Manpower Information System (DMIS) and as obtained from the Defense Manpower Data Center (DMDC).

F. METHODOLOGY

Acting on behalf of the primary beneficiary of services (the patient), physicians utilize various hospital services and are, therefore, the primary customer (surrogate consumer) of hospital-based health care services. Assuming clinical judgments are correct and holding all other factors constant, physician productivity will be evaluated in terms of the administrative/clerical complement. Since not all physician specialties are at risk, only those specialties most needed to meet the Navy's current and anticipated future needs will be assessed. Within this context, this thesis will examine the effect that the administrative/clerical staff has on hospital productivity, using a single measure of physician productivity as a surrogate.

G. ORGANIZATION OF THE THESIS

This thesis will be organized to provide a logical progression to the development of a model that seeks to explain the relationship between physician productivity and administrative/clerical support. Chapter II will provide the reader with a description of current manpower standards and how they are derived. It will also provide an overview of MEPRS: how workload is reported and performance is measured. Chapter III will describe the research methodology and describe the variables used in the model. Chapter IV is the analysis of the data, including limitations of the data and/or

the research. Finally, chapter V will provide conclusions and recommendations for follow-on research.

II. BACKGROUND AND LITERATURE REVIEW

A. THE MILITARY HEALTH SERVICES SYSTEM

The Military Health Services System (MHSS) is an immensely large and complex organization comprised of the three branches of service, Army, Navy and Air Force (the direct care system) and the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS). The direct care system includes 148 hospitals, over 800 medical and dental clinics, and an active workforce of approximately 400,000 military, reserve, and civilian personnel. The MHSS serves a beneficiary population of nearly 9 million. [Ref. 11] Serving as principal adviser to the Secretary of Defense on DoD policies and programs, the Assistant Secretary of Defense (Health Affairs) (ASD(HA)) is also responsible for the management and supervision of the MHSS. Functioning rather independently, each branch of service has a Surgeon General who reports to the service chiefs, who in turn report to their respective service secretaries, as shown in Figure 1. Note: OCHAMPUS reports directly to the OASD(HA). In the past the "ability of the ASD(HA) to ensure effective implementation of congressional and Department of Defense intent in the medical arena has been limited and often criticized." [Ref. 12] However, in an effort to control the increases in healthcare costs and declining workloads, the role of the OASD(HA) has

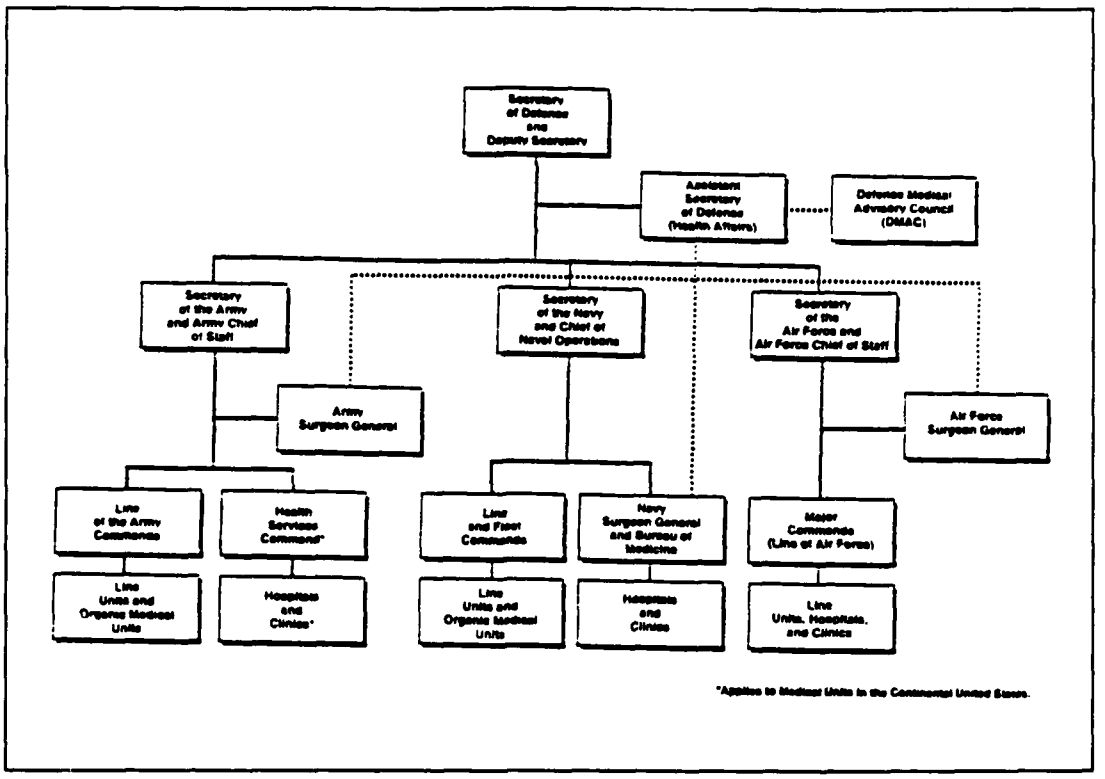

Figure 1. Military Health Services System Organization

Source: Lanier, J.O. and Boone, C., "Restructuring Military Health Care: The Winds of Change Blow Stronger," Hospital and Health Services Administration, Vol 38:1, Spring 93

been expanded and its authority strengthened. Simultaneously and using a more collaborative approach, the Office of the Assistant Secretary of Defense (OASD(HA)) and the service components are continually seeking ways to contain costs, improve productivity and correctly identify resource requirements.

1. CHAMPUS Increases

As reported to the Chairman, Subcommittee on Defense by GAO in July 1989, since 1985 CHAMPUS costs have increased

at twice the rate of the non-CHAMPUS portion of the DoD's healthcare expenditures, as shown in Table 2 [Ref. 13]. Increased use of non-availability statements and decreases in both the number of outpatient visits and inpatient admissions (within the direct care system) are three primary reasons for the rapid increase in CHAMPUS costs.

Table 2. DOD MEDICAL CARE COSTS

(in millions)	FY85	FY86	FY87	% CHANGE
CHAMPUS	1,371	1,735	1,964	43.2
NON-CHAMPUS	7,841	8,651	9,532	21.6
TOTAL	9,212	10,386	11,496	24.8

Source: GAO/HRD-89-47, "Workload Reductions at Military Hospitals Have Increased Champus Costs," July 90, p.10, FY85-FY87

2. Declines in Productivity Within the Direct Care System

Although there were other minor factors in addition to those stated above that contributed to increased CHAMPUS costs, collectively these minor factors accounted for approximately 20 percent of the $690 million increase between FY 85-87, as reported by the GAO in July 1989. The remaining 79 percent increase in CHAMPUS costs was the result of reductions in workload at the Military Treatment Facilities (MTFs), most of which were within the MTF catchment area and experienced by Navy as indicated in Table 3. [Ref. 14] Several reasons were given by GAO for the decline in MTF workload. Although the study acknowledged shortages in

physician staffing, the primary focus was on cost containment initiatives such as CHAMPUS Reform Initiative (CRI), partnerships, and contractor operated primary care clinics.

Table 3. CHANGES IN INPATIENT ADMISSIONS AND OUTPATIENT VISITS BETWEEN FISCAL YEARS 1985 AND 1987

Branch	Change in Inpatient Admissions	Percent Change	Change in Outpatient Visits	Percent Change
Army	400	0	-243,000	-02
Navy	-44,900	-32	-2,200,000	-33
Air Force	-19,500	-10	-199,000	-02
TOTAL	64,800	-42	-67,442,000	-37

Source: Adapted from GAO/HRD-89-47, "Workload Reductions at Military Hospitals Have Increased CHAMPUS Costs," July 90, p.3.

A second GAO study interested in recapturing CHAMPUS workload within the direct care system compared the costs of providing patient care services under three scenarios - military, civilian or contract providers. They first calculated the occupancy rate based on "designed" bed capacity (number of beds that wards or rooms were designed to hold). An average occupancy rate of 45 percent was calculated for all hospitals within the direct care system. Since this definition does not take into account the number of beds the MTF has resources to staff (which may be/often is substantially fewer), the rate calculated is understated and gives the MTF the appearance of being less productive. They

then ranked all hospitals in terms of workload reductions and increased CHAMPUS costs. The six facilities with the highest ranking, indicating the poorest performers, were selected for the study. [Ref. 15] GAO concluded that the potential for savings appeared significant, but realizing these savings would be limited. The "type, availability, and source of additional staff needed" was one of the five limitations cited [Ref. 16]. This staff limitation is further constrained by uncontrollable factors external to the facility and the MHSS.

First, the number of active duty personnel is constrained by Congressionally imposed ceilings, which makes the workload-driven procurement of medical officers, nurses and enlisted technicians difficult. Second, the ready substitution of military medical personnel by civilian federal employees is also constrained because of the lack of salary competitiveness between federal salaries and the civil sector labor market. The third constraining factors is the slow and cumbersome process of acquiring staff through contracts because of the lack of responsiveness to medical marketplace forces. Also important with respect to the first constraint is the fact that, in some specialties, year end strength has fallen below the authorized (imposed) levels across all branches of service as indicated in Table 4. In FY 1990, for example, all specialties listed were undermanned for all services, except pediatricians and anesthesiologists who were

undermanned in only the Navy and Air Force [Ref. 17]. Apart from the obvious differences in budgeted end-strengths one explanation might be the retention factor for each of the services.

3. Physician Retention

As part of the OSD Health Professionals Special Pays Study, the Center for Naval Analysis (CNA) conducted a study comparing physician retention rates among Army, Navy and Air Force. The purpose of the study was to evaluate the need for a new special pay program. In the aggregate physician continuation rates showed little changes between fiscal years 1980 and 1988, averaging 90 percent for Army and 88 percent each for Navy and Air Force. However, retention rates declined to 52 percent (Army), 43 percent (Navy) and 48 percent (Air Force) for those physicians at the end of their initial obligation. [Ref. 18] Table 5 shows retention rates for initial obligors disaggregated by specialty. The Army has the highest retention rates in 17 of the 19 specialties, while both the Navy and Air Force has the lowest rates in 9 of the 17 specialties. In addition, the lower retention rates are not consistent across services, although anesthesiology appears to be uniformly low. One reason for this inconsistency is the accession source used by each service to procure physicians. There are three basic sources,

Table 4. PHYSICIAN YEAR-END STRENGTHS

Physician Specialty	Budget Auth	Year End Strength	% Auth Year End
Anesthesiology			
Army	118	118	100
Navy	157	141	90
Air Force	114	92	81
Family Practice			
Army	450	329	73
Navy	253	230	91
Air Force	442	419	95
General Internists			
Army	208	169	81
Navy	117	100	85
Air Force	144	129	91
General Surgery			
Army	208	169	81
Navy	117	100	85
Air Force	144	129	91
OB/GYN			
Army	214	194	91
Navy	147	104	71
Air Force	204	196	96
Orthopedic			
Army	170	125	74
Navy	142	99	70
Air Force	148	112	76
Pediatricians			
Army	257	269	104
Navy	183	177	98
Air Force	274	251	92
Psychiatry			
Army	218	171	78
Navy	117	100	85
Air Force	144	129	91

Source: DoD, Health Manpower Statistics, FY 1990

Table 5. RETENTION RATES FOR PHYSICIANS AT THE END OF INITIAL OBLIGATION, FY 1984-1987

Specialty	Army		Navy		Air Force	
All specialties	58	(1,957)	43	(1,328)	46	(1,554)
Anesthesiology	32	(84)	27	(74)	18	(50)
Cardiology	59	(44)	27	(15)	29	(14)
Dermatology	74	(54)	59	(17)	56	(16)
Emergency	38	(70)	44	(9)	25	(24)
Family Practice	51	(191)	47	(142)	48	(340)
Gastroenterology	53	(38)	18	(11)	17	(12)
General Surgery[a]	75	(145)	46	(76)	62	(133)
Internal Medicine[b]	58	(282)	44	(119)	45	(182)
Neurology	55	(38)	58	(12)	39	(18)
Neurosurgery	67	(15)	40	(5)	42	(12)
OB/GYN	54	(175)	31	(68)	42	(134)
Ophthalmology	55	(60)	55	(22)	31	(29)
Orthopedic Surgery	61	(132)	36	(33)	36	(58)
Otolaryngology	49	(39)	25	(24)	48	(29)
Pathology	80	(129)	51	(33)	59	(39)
Pediatrics	63	(156)	54	(68)	47	(152)
Psychiatry	63	(106)	54	(41)	47	(58)
Radiology	49	(127)	32	(75)	19	(96)
Urology	54	(50)	42	(26)	43	(28)
Other			70	(27)	71	(130)

Note: Population size in parentheses.

a. Includes general surgery, surgical oncology, colon-rectal surgery, peripheral vascular surgery, and plastic surgery.
b. Excluding cardiology and gastroenterology.

Source: Graham, Amy E., "A Comparison of Physician Retention in the Army, Navy and Air Force", Center for Naval Analyses, June 1989

each of which require different initial obligations depending on the amount of training the physician has received from the military. One source, direct accessions, represents those physicians entering the service fully trained, incurring the least obligation (2-4 years) depending on the contract agreement. It has the greatest apparent impact on initial obligor accessions. Between 1984 and 1987 40 percent of Army, 33 percent of Navy and 16 percent of Air Force procurement, were direct accessions. Another explanation may involve the

non-pecuniary aspects of military medicine and may differ by branch of service. Assuming all physicians have the same civilian opportunities for pay, then such factors as working conditions and job satisfaction may influence their decision. Several studies have been conducted specifically looking at the retention behavior of military physicians (GAO 1989, GAO 1990). While the data for these studies have been based on survey responses, in most cases, physicians feel they are not adequately supported in terms of their administrative staff. In fact, in the GAO study mentioned in Chapter I (reference 8), 86 percent of the physicians surveyed indicated that there were too few clerks, receptionists and secretaries. Initial obligors reported spending an average of 11.3 hours per week on non-physician tasks. [Ref. 19] GAO concluded that reducing the amount of non-physician tasks could result in an estimated decrease in the probability of their leaving of 44 percent for initial obligors and 20 percent for all others.

Most of the studies discussed in this section have all focused on reducing CHAMPUS expenditures and improving hospital productivity through various alternatives. During the period of these studies it appears that Navy MTFs have been less productive based on declining workload. Equally, Navy physicians are more dissatisfied with their working conditions, and have lower overall retention rates than their counterparts in the other services. Based on the assumptions that (1) appropriate levels of administrative/clerical

personnel will positively influence physician retention rates, and (2) the potential for CHAMPUS savings is greater when providing patient care through the direct care system, a determination of administrative/clerical staffing requirements provides system-wide benefits. However, rather than rely on somewhat subjective analyses, such as those provided by self-assessment, more quantitative analysis is needed to determine exact staffing requirements.

B. THE DEPARTMENT OF THE NAVY

1. Administrative/Clerical Support

During fiscal year 1987, prior to the establishment of the Blue Ribbon Panel (BRP), the Bureau of Medicine and Surgery (BUMED), formerly Commander, Naval Medical Command (COMNAVMEDCOM), conducted a study of the deficiencies in total clerical support assets. From this study, 411 additional clerical positions were identified for Navy MTFs. The Secretary of the Navy (SECNAV) approved these additional clerical assets without additional funding, and restricted their placement to the direct support of medical care functions. Without funding by SECNAV, the costs of providing additional personnel had to be borne out of COMNAVMEDCOM's (now BUMED) existing budget. When asked by the Chief of Naval Operations (CNO) to demonstrate the recapture of CHAMPUS workload, "no strong connection" could be made between changes in CHAMPUS productivity and/or changes in MTF productivity,

because "no measurable productivity indicators were requested, and COMNAVMEDCOM [now BUMED] did not initially direct activities to maintain such data." [Ref. 20].

Following the BRP recommendation and approval by SECNAV, Congress authorized an additional $15 million for medical personnel for FY 1989, some of which was used for clerical support. In FY 1990, Congress authorized another $50 million. Of the 904 civilian requirements identified, 440 were clerical support positions for patient care areas. Clearly, the intent of SECNAV was to support direct patient care. However, because managing to payroll gives the local MTF commander the authority to hire based on local needs, hiring practices and financial constraints, there is no guarantee that positions will be created and/or maintained as intended by higher authority. Nonetheless, between FY 1987 and FY 1990, over 1,000 civilian clerical personnel were added to the rolls of BUMED activities, the largest gains occurring during the unfunded periods, FY 1987 (274) and FY 1988 (707). [Ref. 21] Why then in 1990 were physicians still dissatisfied with the level of administrative/clerical support? Possible explanations may include:

- False perceptions by physicians of their needs
- Inefficient use of staff by workcenter managers
- Physicians were not the beneficiaries of the needed additional staff

- Actual requirements were not correctly identified because the relationship to physician output has not been quantified

2. Specialty Requirements

Much has been said thus far about workload and retention and the problems in these areas that make requirements determination and productivity important issues for manpower planners. However, several other factors are equally important, particularly in the midst of a changing healthcare environment. Prior to the end of the cold war, the dual mission of Navy medicine had both complementary and conflicting effects. The critical wartime specialties, general surgery anesthesiology, orthopedic surgery and neurosurgery, could be applied in peacetime to treat eligible beneficiaries. Other peacetime specialty requirements include internal medicine, psychiatry, pediatrics, and obstetrics/gynecology, where demand exceeds the available resources according to BRP findings. Today, however, with the demise of the cold war, redefinition of the national threat, and the need to contain healthcare costs, the distinction between critical wartime specialties and those needed during peacetime are becoming more balanced as the MHSS moves towards an environment of managed care. [Ref. 22]

The Coordinated Care Program (CCP) established in 1992 by OASD(HA) represents military medicine's adoption of a managed- care philosophy. Although the medical mission remains dual in nature, under CCP the military departments

(services) can better accomplish their medical missions by improving beneficiary access and controlling healthcare costs at the local MTF level. Central to the concept of managed care is the establishment and management of a "network" of health care providers and organizations based on local MTF capabilities, needs and costs. Two of the guiding principles of CCP are (1) decentralized management and authority at the local MTF level, and (2) centralized direction and monitoring by the Services and OASD(HA). One of the key features of the program is the delivery of care. Central to the delivery of care is a primary care provider, "a specific primary care clinic, site, provider or group of providers, with which each enrolled beneficiary will establish and maintain an ongoing medical affiliation." [Ref. 23] Primary care physicians act as "gatekeepers", managing the total care for each patient and controlling utilization, therefore, attendant healthcare costs.

Another consideration is the supply of physicians in the civil sector labor market from which to draw military physicians. With the growing trend toward an "overproduction of specialists and an underproduction of generalists (i.e. family physicians, general internists, and general pediatricians) ... 50 percent of the U.S. physicians graduating should be generalists." [Ref. 24] Table 6 shows the distribution of all federal and non-federal physicians in 1990. For comparative purposes, it also shows

the distribution percentages for military physicians on active duty. In the three wartime specialties listed the distribution within the military falls one percentage point below those within the civilian sector. However, within the primary care specialties, the distribution within the military falls 2 percentage points or greater below their civilian counterparts, except family practice. These lower distributions reflected in Table 6, coupled with the manning rates in Table 4, the retention rates in Table 5, and the "reduced emphasis on the surgical specialties" (Reference 22) indicate the need to maintain or improve physician staffing and productivity in the primary care area.

C. REQUIREMENTS DETERMINATION

This thesis presupposes that there is a quantifiable relationship between physician satisfaction and productivity and the clerical staff which will be described further in Chapter III. However, before moving directly into that discussion this section of the chapter will describe the current method mandated by OASD(HA) to define health manpower personnel requirements and discuss current literature on this subject.

Two programs focusing entirely on the determination of manpower requirements are Efficiency Review (ER) and the Joint

Table 6. DISTRIBUTION OF FEDERAL AND NON-FEDERAL PHYSICIANS

Specialty	Civilian Sector Number	Percent	Military Services Number	Percent
Total	600,789	4	13,795	3
Anesthesiology	25,367	8	351	7
Family Practice	46,302	6	978	4
General Surgery	38,240	6	533	4
OB/GYN	33,095	6	494	4
Orthopedic Surgery	18,741	3	336	2
Pediatrics	39,457	7	696	5
Psychiatry	34,540	6	400	3
Internal Medicine	97,486	16	586	4
All others	267,561	44	9,421	68

Sources:
Civilian Data: Physician Characteristics and Distribution in the U.S., 1990 Edition
Military Data: DoD, Health Manpower Statistics, FY 1990

Healthcare Manpower Standards (JHMS), mandated by the Secretary of Defense and the OASD(HA), respectively. While both programs are designed to provide quantitative methods to determine manpower requirements, the JHMS is an integral part of the ER process.

1. Efficiency Review

The accurate identification of personnel needs and efficient facility operations are of key concern throughout the Department of Defense. In fact, DoD policy states that:

> DoD Components shall manage, provide resources, and evaluate programs based on output performance requirements and standards documented in performance work statements (PWSs). The ER process shall be the basis for continued and directed efforts for productivity, performance, efficiency and effectiveness improvement. [Ref. 25]

Within the Department of the Navy,

> the ER process reviews and assesses workload in terms of the activity's mission, functions and tasks; objectively reviews and determines the equipment and processes necessary for the activity to efficiently and effectively discharge its mission and tasks; **determines the number and defines the skills and mix of military, civilian, and/or contractor manpower resources required based on measured/validated workloads/tasks;** and provides claimant the flexibility, due to having a workload based staffing guide or other recognized analytical tool, to adapt personnel strength requirements as programs or mission changes occur. [Ref. 26]

The key feature of ER is that it is designed to determine **manpower requirements** based on a thorough review of the whole facility (i.e. a Naval Treatment Facility) using a variety of quantitative methods that result in the most efficient utilization of resources.

2. Joint Healthcare Manpower Standards (JHMS)

Upon recommendation of the Blue Ribbon Panel (BRP) and by direction of the Secretary of Defense, in July 1985, a joint service project team was established to develop a "joint" staffing methodology. In March 1989, OASD(HA) issued the first set of JHMS for use by all DoD Components and the Military Services. Two of the five objectives of the JHMS are to provide:

1. Military healthcare management a uniform process for determining requirements and applying military treatment facility staffing standards,
2. A method for forecasting healthcare manpower

requirements based on mission and/or service population changes. [Ref. 27]

The JHMS apply to fixed Military Treatment Facilities (MTFs) which provide direct patient care which includes all hospitals, medical centers (i.e. teaching/referral facilities) and branch clinics. Use of the standards requires the collection of manpower and workload data that, when applied consistently with the standard, results in the proper and uniform distribution (mix) of personnel requirements. How a standard is derived determines the type of classification it receives and the degree to which they must be applied at the local MTF level. There are three general classifications, Types I, Types II and III, and Manpower Guide. [Ref. 28] Refer to Appendix B for a description of the types.

A discussion with the Navy Representative on the Joint Healthcare Manpower Engineering Team (JHMET) indicated that it was very difficult to determine (quantify) the technical and clerical staff requirements based on utilization differences among the hospitals and inconsistencies regarding the basic organizational structure. During the first draft of the development of the standards, physicians were asked to define the work they did. Based on their responses preliminary standards were developed that were met with unfavorable response because the technical/clerical requirements were understated. The standards were adjusted based on the work physicians did that should have been performed by

administrative support personnel. [Ref. 29] The resulting standards allowed for more support staff, however, below the extended provider level the JHMS may not reflect the most accurate statement of requirements. As noted by the services the standards were developed too quickly, have not been validated, and do not address their specific needs." [Ref. 30] Another possible shortcoming of the standard might be the implied substitutability of technical and clerical manpower. For example, the JHMS for Orthopedic services (DoD 76104) shows that for a non-GME facility with workload (visits) between 662.2 and 4,2885.5 the staffing at the various levels is as shown in Table 7. Note that technicians and administrative/clerical requirements are considered substitutable. This relationship is depicted in Figure 2. There are two problems with this theory. First, it implies that any combination of clerks and technicians along the equal output curve yields maximum levels of output. While it is agreed that a technician can perform some clerical functions, clerical personnel cannot perform technical work center functions, which suggest that these two labor inputs are complements, not substitutes. Second, it represents false savings - if clerks can be purchased at a lesser wage than technicians then the cost minimizing facility will want to hire more clerks, perhaps at the expense of the capacity to perform patient services. These ideas are supported by Fottler, who in 1972, stated "if two labor factors are treated

Table 7. Joint Healthcare Manpower Standard for Orthopedic Services

JOINT HEALTHCARE MANPOWER TABLE II										
WORK CENTER TITLE/CODE: Orthopaedic Services DoD 6104	EXTRAPOLATION LIMITS: 662.159 - 4285.46918 See Application Instructions									
SPECIALTY TITLE	MANPOWER REQUIREMENTS									
Provider	2	3	3	4	4	5	5	6	6	7
* Medical Technician	2	2	2	2	3	3	4	4	5	5
* Administrative Support	1	1	2	2	2	2	2	2	2	2
TOTAL	5	6	7	8	9	10	11	12	13	14
SPECIALTY TITLE	MANPOWER REQUIREMENTS									
Provider	7	7	8	8	8	9	9	10	10	11
* Medical Technician	5	6	6	7	7	7	8	8	9	9
* Administrative Support	3	3	3	3	4	4	4	4	4	4
TOTAL	15	16	17	18	19	20	21	22	23	24
SPECIALTY TITLE	MANPOWER REQUIREMENTS									
Provider	11	12	12	13	13					
* Medical Technician	10	10	10	10	11					
* Administrative Support	4	4	5	5	5					
TOTAL	25	26	27	28	29					

* NOTE: Medical Technician and Administrative Support requirements may be substituted for one another according to Service/local needs.

Source: Joint Healthcare Manpower Standards

as substitutes but the result is a decline in the quality ofservice, then the two labor factors are, in fact, complements." [Ref. 31] While quality determinations are beyond the scope of this thesis, it is assumed that quality will decline based on the different levels of training and skills required to perform each job separately as

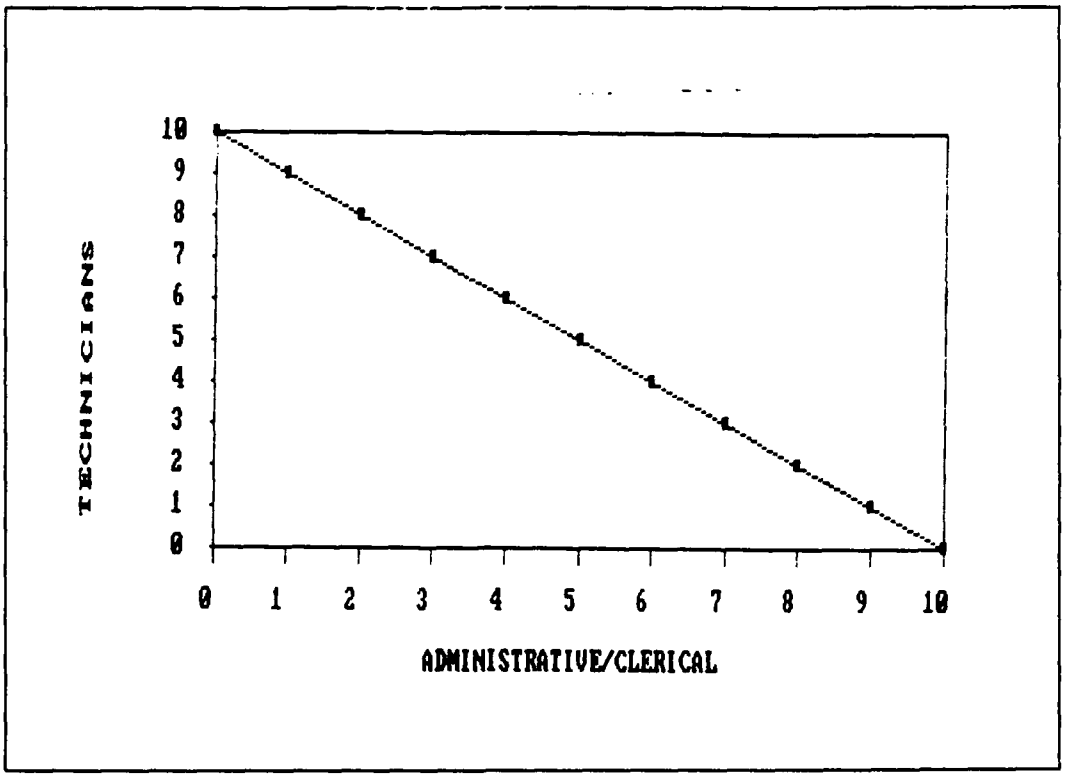

Figure 2. Equal Output Curve for the Substitution of Administrative/Clerical personnel with Technicians.

indicated by differences in the wages.

D. CHAPTER SUMMARY

Collectively, these findings seem to suggest that as a prerequisite Navy medicine must first determine the relationship between the administrative/clerical support and physician productivity. Once this relationship is known changes in productivity can be properly offset by changes in the administrative/clerical staff complement. The focus now is to examine the impact that clerical staff has on physician productivity, the subject of Chapter III.

III. PRODUCTIVITY

A. EFFICIENCY AND PRODUCTIVITY

Since a hospital is not a single product organization, the concept of "hospital" efficiency has been difficult to clearly define, particularly within the context of the "whole" hospital. Efficiency, often used interchangeably with productivity, has been commonly defined as the ratio of outputs to inputs without regard to the quality of the output. Simply, it means production at the lowest possible cost [Ref. 32]. Within business and industry the two most common measures of efficiency are reductions in unit costs and productivity. While productivity is a more sophisticated measure than a simple cost reduction "it is less than a whole concept of efficiency" for two reasons [Ref. 33]. First, the organizational inputs (land, labor and capital) are diverse and cannot be added without first developing a common measure, such as dollars. Then, equitably or not, the indirect and overhead costs of support functions such as radiology or outpatient records must be allocated to each workcenter to determine the total cost of the product. The second problem is that of defining standard units of measurement for hospital outputs, that is, measures that account for the differences in the complexity and intensity of care. These factors are equally important when looking at

efficiency at the workcenter or physician levels, as well. Since this study is interested in productivity at the physician level, it will not address the concept of hospital efficiency, except to make the initial assumption that as the physician's productivity improves so will the efficiency of the hospital, holding all other factors constant. Stated differently, physician productivity is highly correlated with hospital efficiency.

At first glance, defining manpower productivity seems pretty straightforward. "The average productivity of any type of manpower is the 'output' produced by one unit of that manpower during a given period [Ref. 34]." However, in healthcare, particularly regarding medical practice, defining output poses conceptual problems. Measuring physician output along the lines of impact to the patient's health seems sensible, but is not easily accomplished empirically given the vast array of inputs that must be controlled for. If it were possible to predict patient health in the absence of physician intervention then it might be possible to bridge the gap between conceptual and empirical reality.

A more useful approach has been to view the physicians output as "physician services" based on some index of the volume of services rendered during a given period [Ref. 35]. Viewed this way, the physician assumes the role of consultant. In addition, based on his/her medical judgment as to what other services are required in both the

diagnosis and treatment of the patient's condition, it is the physician who uses the array of other services, while it is the patient who benefits from them. In the civilian sector this relationship could be depicted numerous ways depending on the practicing status of the physician.

In private or group practice, for example, the physician is free to choose "where" diagnostic and treatment services come from. Within the military, this relationship does not hold true unless the needed services cannot be provided within the MTF. This relationship is depicted in Figure 3.

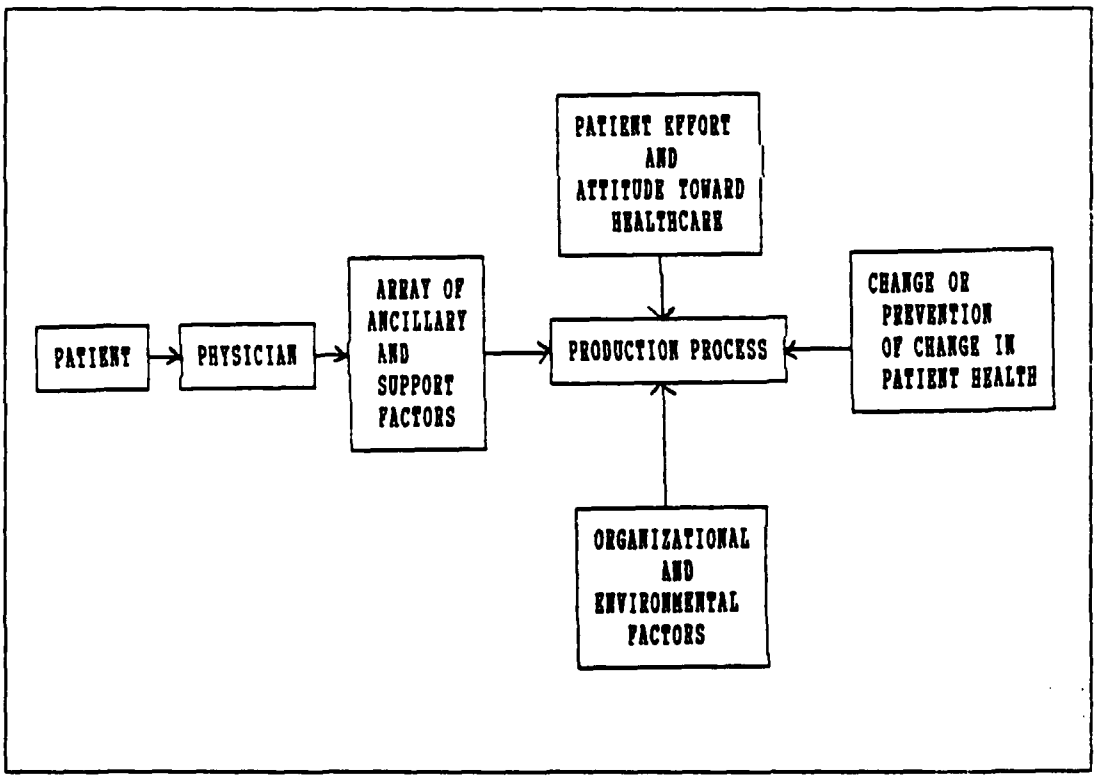

Figure 3. Adapted from Reinhold, "The Role of Physician Services in producing Health Care," p.65.

B. RESEARCH METHODOLOGY

Before discussing the methodology, this section will describe the research hypothesis. Initially, the plan was to compare Navy MTFs with civilian hospitals to test the hypothesis that administrative and clerical staff personnel were used less efficiently in Navy MTFs than in similar civilian hospitals. This task turned out to be too difficult given the differences in structure, workload reporting and performance systems, and hiring practices of these two types of organization (military and civilian). Comparisons were in fact, virtually impossible. Equally discouraging were the distinct differences in the organizational environments in which military and civilian physicians practice medicine. As a result of these differences and difficulties, the idea of using civilian hospitals as the comparative group was abandoned. Instead, given the previously discussed decrements in workload and increased physician retention problems, the three branches of service were selected as the comparison groups. A second factor that makes these groups more appealing is the availability of consistent data. In addition, even though the three branches of service have the common factor of being military organizations, it is assumed that enough difference exists among the services with respect to mission and organizational style to account for the variation that is expected to be observed. In other words, although the group of military physicians may be homogenous

within each branch of service, there may be differences when comparing physician work output among the services. While the basic focus of this research is still that of examining the variation in the utilization of administrative/clerical personnel and the impact of this staff component on physician productivity, the initial hypothesis was adjusted. Navy physicians, because of their higher levels of dissatisfaction and lower rates of retention, are expected to be less productive than their counterparts in the Army and Air Force due to the reduced availability of administrative and clerical staff personnel. Although a variety of methods exist to examine this issue, regression analysis will be used because of its ability to describe the functional relationship between physician productivity and the factors that influence productivity. Also, in the absence of prior military research on this subject, the results of this study will serve as a point of departure for future research. To test this hypothesis five steps are required:

1. Establish physician productivity measures
2. Determine the physician production function
3. Collect the data
4. Conduct comparative analysis
5. Interpret results

The remainder of this chapter will discuss steps 1 through 3 while steps 4 and 5 will be discussed in Chapter IV.

C. PRODUCTIVITY MEASURES

In the absence of specific data, historical physician productivity measures were estimated using proxies. Some of the more popular measures included (1) annual gross receipts or annual expenditures; and (2) periodic ratios of physician-patient visits, indicating volume on an hourly, weekly or annual basis. Using gross receipts or expenditures does not accurately reflect physician productivity because included in these figures are the services of ancillary and auxiliary staff. An increase in gross receipts could imply an increase in productivity, whereas an increase in expenditures could imply a decrease. This is also true within the military where final workcenter costs include both the direct and indirect costs associated with producing healthcare. Further, this sort of data is unavailable at the local MTF level because of differences in funding and local accounting procedures. [Ref. 36] More recent studies use patient volume data to establish productivity ratios.

Using patient volume allows the researcher to separate those activities actually performed by the physician from those performed by other medical and nonmedical personnel. In so doing, activities that the physician performs that are non-physician tasks can be identified for reassignment to other personnel or capital equipment. Accordingly, increases in patient volume implies an increase in physician productivity while the converse is true with decreases in the number of

patients seen, ceteris paribus. However, caution must be used in this interpretation since decreases may also reflect, for example, increased severity or higher intensity of services requiring more patient contact time. One way to control for this possibility would be the inclusion of actual patient contact time as obtained from the patient discharge record; however, since quality is not the issue of this paper, it will not be further addressed. Rather this study assumes that all physician output is of the same quality and that improved physician productivity will improve hospital productivity to the extent that the hospital operates efficiently and within the constraints of its organizational mission and fiscal limitations.

Past analyses found that physician time input is the most important determinant of physician productivity. According to Hurdle and Pope, physician productivity has two components - work effort and actual output. Work effort is defined as physician hours per year while productivity is visits per physician hour. Although their study focused on private practice physicians, their method has useful military application as well. However, their data is based on estimates provided by physicians via survey, which may have produced biased results. In addition, they did not account for differences between physicians on fixed salaries and those whose income is free to vary, which might also produce biased results.

One advantage of this research is the relative homogeneity of military physicians. Since they all self-select into the military their personal characteristics and preferences may be similar, although differences with respect to branch-of-service selection may exist. These differences may be reflected in higher retention rates in the Army compared to the Navy and Air Force as well as higher dissatisfaction rates among Navy physicians.

1. Trends in Physician Productivity

a. Civilian Productivity Trends

During the period 1978-1984, annual civil sector physician productivity was believed to have declined as noted by Hurdle and Pope (1989). Their study attributed the declines to increased intensity of case mix brought about by a decline in hourly productivity rather than lower work effort as had been posited by previous researchers. In addition, they concluded that the number of nurses and administrative aides is significantly and positively associated with physician productivity. This was further supported by Pope in another civil sector study in 1990 [Ref. 37]. Other changes within the civilian community also provide indications of the trends within the healthcare industry:

- The median number of beds decreased from 164 in 1986 to 152 in 1988. During this same period the average length of stay (ALOS) experienced a 3 percent decline and the median occupancy rate was 52.11 (in 1988), all indicating a

downward shift in the use of inpatient hospital services.

- Case mix complexity also increased an average of 2.6 percent per year since 1984 reflecting greater case intensity, probably due to an aging population.
- Staffing levels also decreased. The median number of FTE personnel per adjusted average daily census declined from 4.33 in 1987 to 4.28 in 1988, indicating an increase in operating efficiency.
- Outpatient utilization increased. [Ref. 38]

b. Trends Within The Direct Care System

Similar changes have occurred within the military. From the period 1987-1991 the number of MEPRS direct care admissions declined 8.5 percent as did the Average Daily Patient Load (APDL) by 20 percent.

Total visits increased 1.8 percent, with the largest gain in the Air Force in FY90 and decline in FY91. [Ref. 39] Both Army and Navy have experienced steady growth from 1987 to 1990 with only slight increases as depicted in Figure 4.

Within the primary care areas total visits have declined slightly for Air Force, while increasing for both Army and Navy as shown in Figure 5. Family practice visits appear to be declining for Air Force while increasing for both Army and Navy. In addition, Navy family practice visits declined sharply between fiscal years 85 through 87, then began its upward trend. Pediatric visits show small

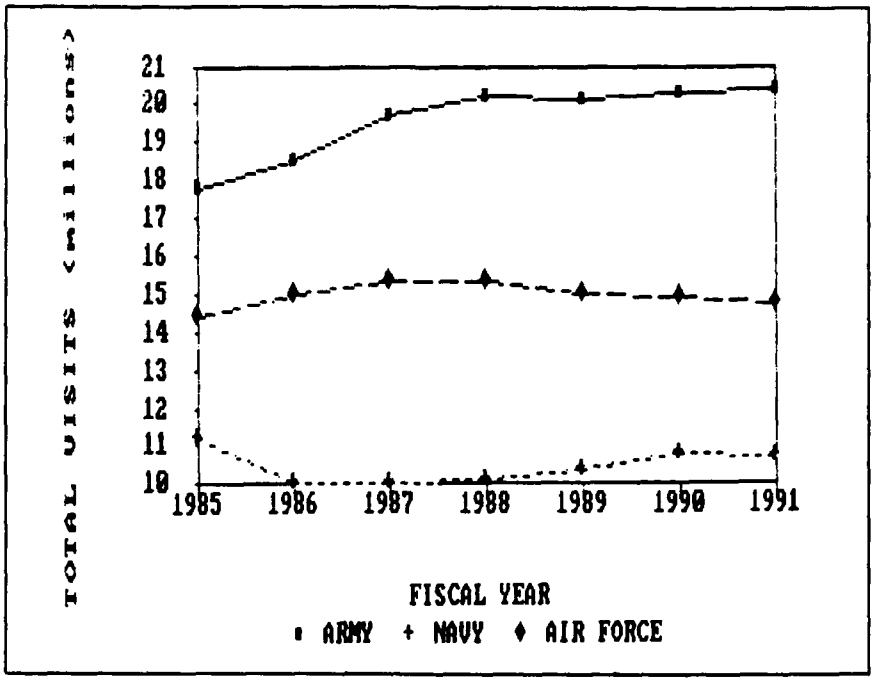

Figure 4. Total Annual Visits, Fiscal years 1985-1991

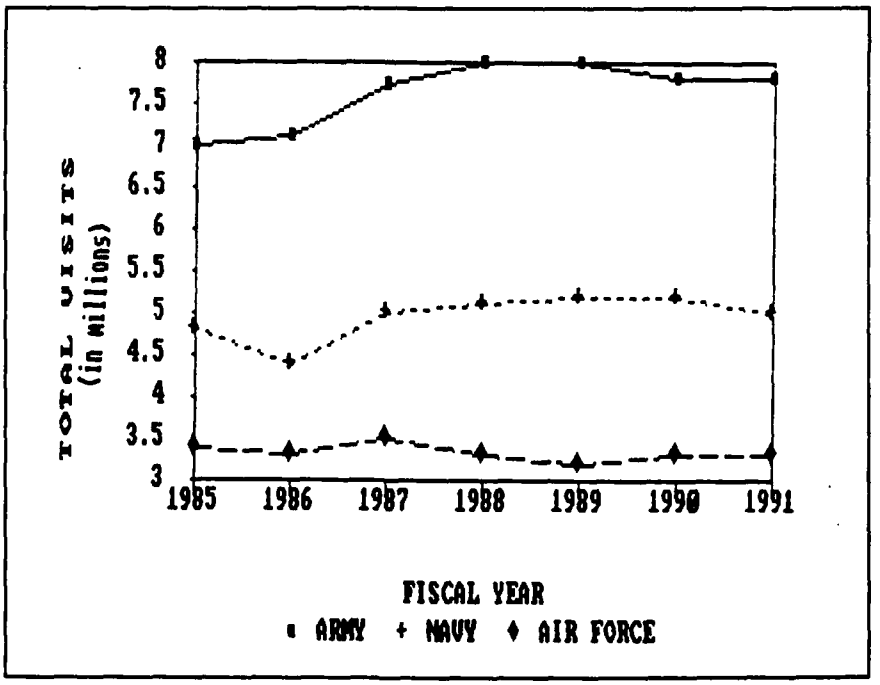

Figure 5. Primary Care Visits, Fiscal years 1985-1991

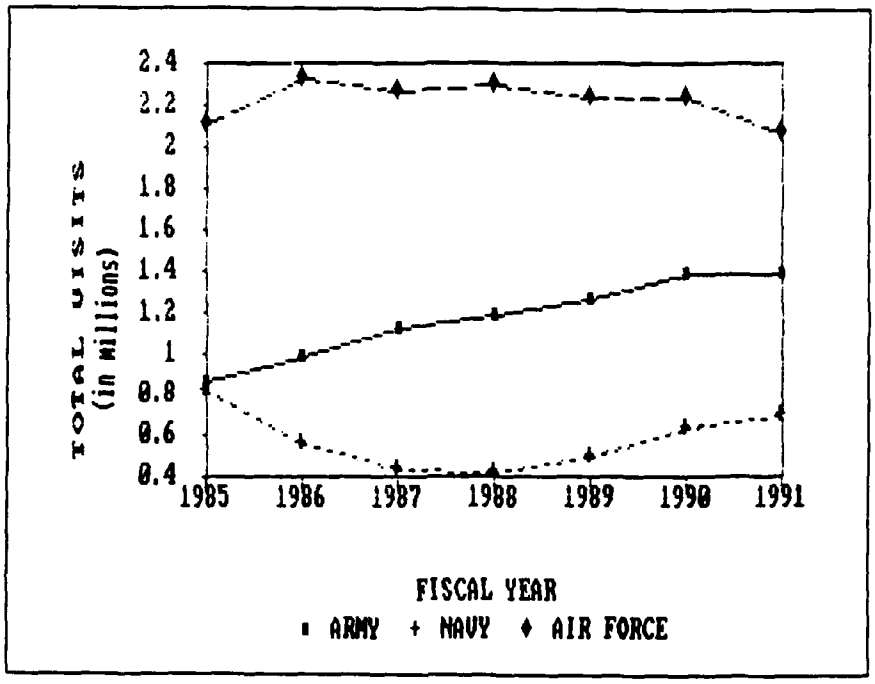

Figure 6. Family Practice Visits, Fiscal years 1985-1991

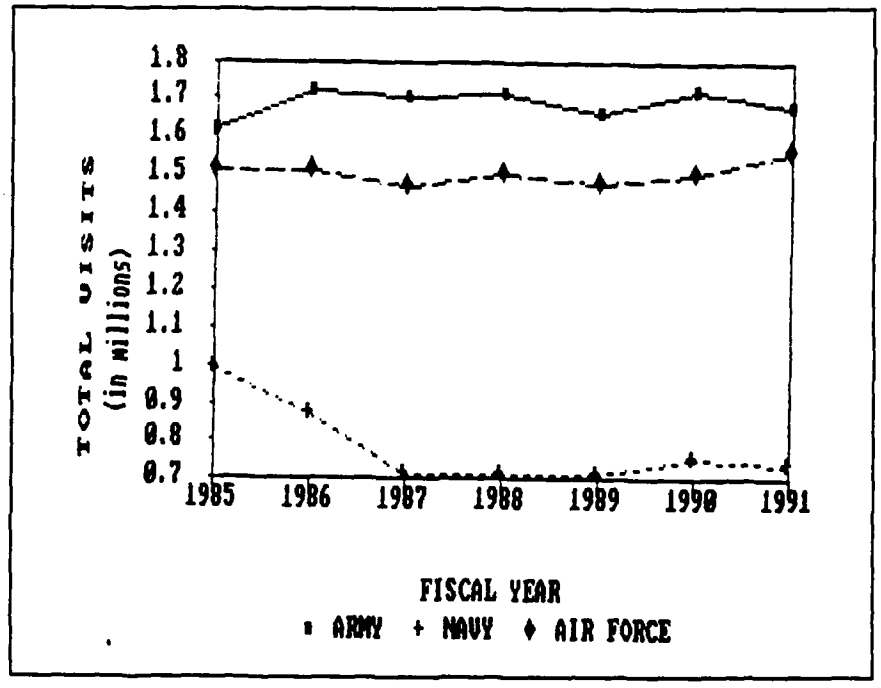

Figure 7. Pediatric Visits, Fiscal Years 1985-1991

fluctuations for Army and Air Force. Navy pediatric visits decline sharply between fiscal years 85 through 87, remained constant between 1987 and 1988 with growth during 1990 and 1991.

D. PRODUCTION FUNCTION

Physician productivity is influenced by available physician input hours, as well as other structural hospital and staffing variables:

$$Q = f(F, \mathbf{S}, \mathbf{H}, \mathbf{L})$$

where Q = annual physician output (visits), F = physician time input, S = vector of structural variables, H = the vector of hospital variables and L = the vector of non-physician labor inputs. Excluded from the function are the personal physician attributes such as age, sex, nationality that may also affect practice style and productivity, this exclusion being due to insufficient data. Ideally, some measure of these personal variables should be included. The omission of these variables could lead to a bias in the estimated effects of the included variables.

1. Dependent Variables

A single measure of physician productivity will be used as the dependent variable in estimating the production function: Total visits (TOTVIS), which incudes both annual inpatient and outpatient visits. Annual outpatient visits

include all presentations of eligible beneficiaries to an organized clinic or specialty service for examination, diagnosis, treatment, evaluation, consultation, or medical advice or is treatments in personal quarters that are documented in patient medical records. Total visits include not only these outpatient visits but also those visits that show as expenses in non-ambulatory accounts, including special programs as well as inpatient. Examples include visits by the physician to inpatients on hospital wards and visits to the physician from inpatients as well as Alcohol and Drug Rehabilitation and community health services. Thus total visits captures all physician workload. There are several disadvantages with using this measure. First, patient care provided by extended providers, for example, physician assistants and nurse practitioners, also constitutes a visit and is included in this figure which does not allow for the isolation of productivity by the physician alone. Second, those hospitals with non-independent branch clinics assigned to them roll clinic visits into the figures reported for both outpatient and total visit, thus masking the actual output of the core hospital. Finally, these measure do not capture any of the effects of the quality of care rendered. Ideally, each of these factors should be controlled for, but sufficient data were not available. Consequently, caution must be exercised when interpreting the results of the analysis.

2. Independent Variables

Annual hours worked (CLINFTE) measures the amount of physician work effort that went into producing patient care. Since military physicians are not free to determine their own work hours, it is not possible to know what their labor/leisure preferences would be in the absence of military constraints. A plausible substitute for input hours is the use of full-time equivalent (FTE) because physician FTE includes only the time the physician was available to the workcenter. However, there is one disadvantage to using FTE. It includes time spent at meetings and time spent on other non-physician tasks performed in the workcenter. Although there is no formal method to disaggregate time spent on non-physician tasks from actual patient contact time, physicians estimate this time to be approximately 10 percent (see reference 8, page 30). Variations of any significance should occur among the services rather than within a service, assuming that the overall service medical mission and inherent organizational service constraints are consistent. Table 8 provides all independent variable definitions.

The hospital variables are those that are beyond the control of the physician and the local facility commander that affect efficiency. These include hospital type, occupancy rate, and the relative case mix index.

Two dummy variables were created to separately assess the effect of hospital type. Major teaching facilities

(MAJTEACH) are defined as those that serve as referral centers and have more than one residency program and those that are medical centers or community-type hospitals with only one residency program, for example, family practice. All other facilities, defined as non-teaching hospitals (NONTEACH), serve as the omitted group (n=89). Although previous studies, in general, concluded that physicians in teaching facilities

Table 8. Determinants of Physician Productivity

DETERMINANT	SYMBOL	DEFINITION
Outpatient visits	TOTOPV	Annual number of outpatient visits
Total visits	TOTVIS	Total annual visits
Physician hours	CLINFTE	Total number of annual hours worked measured in FTE
Hospital variables		
Major teaching	MAJTEACH	Dummy variable = 1 if referral center with 2 or more residency programs; medical center/community hospital with 1 residency program, = 0 otherwise
Non-teaching	NONTEACH	Dummy variable = 1 if community hospital 0 = otherwise
Dod Component	ARMY	Dummy variable = 1 Army; 0 otherwise
	NAVY	Dummy variable = 1 if Navy; 0 otherwise
	AIRFO	Dummy variable = 1 if Air Force; 0 otherwise
Occupancy rate	OCCUP	Avg daily patient load (ADPL)/number OPBEDSRel
Case Mix Index	RCMI	Dod Adjusted Case Mix Index
Staffing variables		
Clinician FTE	CLINFTE	Clinician Full time equivalent (FTE)
Professional	PROFTE	Professional FTE
Para-professional	PARAFTE	Para-professional FTE
Registered Nurse	RNFTE	Registered Nurse FTE
Administrative	ADMFTE	Administrative FTE

*RCMI is the CMI adjusted by the DoD base index of .8109
Note: For explanation of terms see Appendix A (glossary)

were less productive than physicians in non-teaching hospitals, more recent studies are not reaching the same conclusions. Kearl and Mainous (1993) concluded that there

was no significant difference in the average number of patients seen by Family Medical Center Physicians with or without a student present. [Ref. 40] Given the priority placed on teaching hospitals by DoD, major teaching facilities are expected to have lower output than non-teaching facilities.

Three dummy variables were created to measure the effect of branch of service on productivity: ARMY, NAVY, and AIRFORCE. Since AIRFORCE has the largest number of hospitals (n=64), it represents the omitted condition.

The occupancy rate (OCCUP), the ratio of the average daily patient load (ADPL) to the number of operating beds, is a general measure of the extent to which capacity is utilized and often serves as an indication of hospital efficiency [Ref. 41]. Increases in this rate suggest a greater use of resources thus an implied increase in the demand for physician time by inpatients. Consequently, higher occupancy rates should decrease outpatient visits (OPV) productivity while increasing total visits (TOTVIS). It is not known whether the effects will be equally offsetting.

The staffing variables include all other non-physician labor inputs grouped into five categories:

- Clinicians (CLINFTE)
- Direct Care Professionals (PROFTE)
- Direct Care Para-professionals (PARAFTE)
- Registered Nurses (RNFTE)
- Administrative, Clerical and Logistics Staff (ADMFTE)

For each of these categories actual hours worked are divided

by 168 to convert hours into full-time equivalents (FTEs). All workload is reported by FTE annualized in the year-end report which is consistent with industry norms. Increases in FTE rates by the "other staff" inputs are expected to positively affect the productivity measure, but with diminishing marginal productivity. [Ref. 42]

E. THE DATA

The data set consists of data for the 123 Army, Navy, and Air Force hospitals located in the Continental United States (CONUS). Branch clinics and non-fixed medical facilities were excluded. Data for 1992 were unavailable and data for 1991 were atypical because of Operation Desert Storm; so data from fiscal year 1990 only were utilized. The data were obtained from the Defense Medical Information System (DMIS) which gathers the data from a variety of sources. Catchment Area Population and beneficiary demographics were obtained from the Defense Enrollment Reporting System (DEERS). Biometric data are reported through Service biometric offices and DEERS. The Defense Medical Facilities Office (DFMO) reports facility descriptive data; bed capacities and workload, performance and expense information is obtained through the Medical Expense and Performance Reporting System (MEPRS). Most of the data used in this analysis is from MEPRS, which is described in more detail in Appendix C. Data were also obtained from the Defense Manpower Data Center (DMDC) as a cross-reference;

however, DMDC data are limited. As expected there were discrepancies with the data, many having to do with how and when data are reported.

IV. RESULTS OF ANALYSIS

A. PRELIMINARY FINDINGS

The total number of CONUS military hospitals in the data set are 123 - 35 for Army (29 percent), 24 for Navy (20%), and 64 for Air Force (52 percent). Although there are more Air Force hospitals, their overall workload is less than that of Army and Navy. In addition, 72 percent of Air Force hospitals have 50 beds or less, compared to 27 percent in Army, and 30 percent in Navy. Table 9 is a listing of the means for select variables within the data set. The means for Army and

Table 9. VARIABLE MEANS

VARIABLE DESCRIPTION*	TOTAL	ARMY	NAVY	AIR FORCE
Annual Dispositions	5782	9206	7085	3421
Occupied Bed Days	27405	43443	32538	16709
Catchment Population	49749	58254	83190	32558
DoD Adj Case Mix Index	.9194	1.0212	.9334	.8585
Number Operating Beds	108	159	141	68
Average Length of Stay	3.9	4.1	4.4	3.5
Avg Daily Patient Load	79	126	94	47
Outpatient Visits	282501	428164	352575	174881
Total Visits	290464	448854	364070	176242
Clinician FTE	116	181	152	67
Professional FTE	44	70	58	25
Paraprofessional FTE	365	484	610	208
RN FTE	93	130	130	57
Administrative FTE	300	510	383	153
RN FTE/CLIN FTE	.9	.85	1.2	.9
ADMIN FTE/CLIN FTE	3.4	3.8	3.8	3.0
PROFESS FTE/ CLIN FTE	.5	.5	.6	.5
PARAPROF FTE/CLIN FTE	4.3	3.7	6.5	3.8
OPV/CLINFTE	2435	2366	2319	2610
TOTVIS/CLINFTE	2503	2480	2395	2630
DISP/CLINFTE 61	67	64	57	
NUMBER HOSPITALS (n=)	123	35	24	64

*All variables not used in quantitative analysis

Navy are consistently higher than the means for Air Force, although average outpatient visits per clinician FTE

(OPV/CLINFTE) is higher for Air Force than Army and Navy which are both below the total mean. Interestingly, Navy has the highest average staffing full-time equivalents, particularly paraprofessionals (PARAFTE) at 6.5, however, assessment of this staff component is beyond the scope of this research.

B. REGRESSION RESULTS (ALL HOSPITALS)

1. Total Annual Visits

This section begins by acknowledging that every effort was made to demonstrate the existence of a significant relationship between administrative/clerical staff and physician productivity. However, despite all efforts, administrative/clerical staff does not make a significant contribution to physician productivity. The basic model began using the functional relationship described in Chapter III. Surprisingly, the administrative/clerical staff variable (ADMFTE) did not turn out to be significant, and even more surprisingly, though significant, physician input hours (CLINFTE) turned out to make a negative contribution, as indicated in Table 10. Although the adjusted R-square is high (.92), indicating good overall fit (i.e. the independent variables explain 92 percent of the variation in the dependent variable), there are significant variance inflation factors, indicating high multicollinearity among the staffing variables, as indicated in Table 11. In addition, there are strong correlations of the staffing variables with case mix

Table 10. ORIGINAL REGRESSION MODEL
DEPENDENT VARIABLE: TOTAL ANNUAL VISITS

Root MSE	67506.51517	R-square	0.9297
Dep Mean	291657.02459	Adj R-sq	**0.9234**
C.V.	23.14586		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	148098	66589.991454	2.224	0.0282
OCCUP	1	-9007.883016	15011.635703	-0.600	0.5497
ARMY	1	-87027	17656.533318	-4.929	0.0001*
NAVY	1	72078	22161.525831	3.252	0.0015**
RCMI	1	-108690	46744.113637	-2.325	0.0219**
MAJTEACH	1	-4795.533853	25617.422900	-0.187	0.8518
CLINFTE	**1**	**-303.732733**	**174.86349402**	**-1.737**	**0.0852*** **
PROFTE	1	1208.172928	386.60343611	3.125	0.0023**
RNFTE	1	358.898201	338.47807436	1.060	0.2913
PARAFTE	1	551.955580	74.32532802	7.426	0.0001*
ADMFTE	**1**	**14.402647**	**39.81451827**	**0.362**	**0.7182**

Variable	DF	Variance Inflation	Variable Label
INTERCEP	1	0.00000000	Intercept
OCCUP	1	1.04447820	OCCUPANCY RATE
ARMY	1	1.70744595	US ARMY FIXED MEDICAL FACILITIES
NAVY	1	2.01145878	US NAVY FIXED MEDICAL FACILITIES
RCMI	1	3.35153427	DOD ADJUSTED CASE MIX INDEX
MAJTEACH	1	2.86240716	REFER CENTER MORE THAN 1 RESIDENCY
CLINFTE	**1**	**22.97779798**	**PHYSICIAN FULLTIME EQUIVALENTS**
PROFTE	**1**	**8.30329966**	**PROFESSIONAL FULLTIME EQUIVALENTS**
RNFTE	**1**	**36.10789723**	**REGISTERED NURSE FULLTIME EQUIVALENT**
PARAFTE	**1**	**19.44568166**	**PARAPROFESSIONAL FULLTIME EQUIVALENT**
ADMFTE	**1**	**5.03333043**	**ADMINISTRATIVE FULLTIME EQUIVALENT**

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

(RCMI), with teaching status (MAJTEACH), and with CLINFTE. These correlations mean that movement in one variable results in an almost identical movement in the others, though perhaps in the opposite direction (where the correlations are negative). Taken together, there seems to be a good deal of multicollinearity within the model.

Table 11. CORRELATION AMONG VARIABLES

CORR	OCCUP	ARMY	NAVY	RCMI	MAJTEACH	CLINFTE
OCCUP	1.0000	-0.1515	0.1002	0.0869	-0.0977	0.0984
ARMY	-0.1515	1.0000	-0.3057	-0.2712	0.0372	-0.2420
NAVY	0.1002	-0.3057	1.0000	-0.0248	0.1707	-0.1159
RCMI	0.0869	-0.2712	-0.0248	1.0000	-0.6987	0.7768
MAJTEAC	-0.0977	0.0372	0.1707	-0.6987	1.0000	-0.7534
CLINFTE	0.0984	-0.2420	-0.1159	0.7768	-0.7534	1.0000
PROOUT	-0.0718	0.0179	-0.1288	-0.2690	0.3951	-0.3711
PARAOUT	-0.1455	0.1999	**-0.6066**	-0.3090	0.4139	-0.4408
RNOUT	-0.1024	0.1752	-0.4969	-0.2818	0.3047	-0.3504
ADMOUT	-0.0354	-0.1935	-0.1340	-0.2465	0.4113	-0.3973
TOTVIS	0.1131	-0.4106	-0.1626	**0.6300**	**-0.6423**	**0.8647**

CORR	PROFTE	RNFTE	PARAFTE	ADMFTE	TOTVIS
OCCUP	0.1170	0.0994	0.0932	0.1095	0.1131
ARMY	-0.3552	-0.2209	-0.2075	-0.3855	-0.4106
NAVY	-0.1695	-0.1804	-0.3426	-0.1294	-0.1626
RCMI	**0.7193**	**0.7759**	**0.6705**	**0.7143**	**0.6300**
MAJTEACH	**-0.6624**	**-0.7693**	**-0.7233**	**-0.6224**	**-0.6423**
CLINFTE	**0.8969**	**0.9710**	**0.9112**	**0.8450**	**0.8647**
PROFTE	**1.0000**	**0.8914**	**0.8868**	**0.8639**	**0.8944**
RNFTE	**0.8914**	**1.0000**	**0.9488**	**0.8177**	**0.8939**
PARAFTE	**0.8868**	**0.9488**	**1.0000**	**0.7766**	**0.9286**
ADMFTE	**0.8639**	**0.8177**	**0.7766**	**1.0000**	**0.7845**
TOTVIS	**0.8944**	**0.8939**	**0.9286**	**0.7845**	**1.0000**

There are four remedies for multicollinearity: [Ref. 43]

1. Increase Sample Size
2. Do Nothing
3. Drop redundant/irrelevant variables
4. Transform Variables

Increasing sample size or doing nothing are not feasible solutions. Since MAJTEACH was significant and highly correlated with other variables, it was dropped from the model, as was RCMI. Neither of these changes produced favorable results - ADMFTE was still not significant, and CLINFTE remained negative. These results are shown in Table 12 and in greater detail in Appendix D. The fourth option was to transform the staffing variables by adding to CLINFTE

professional FTE (PROFTE) to create a new variable (DRPROFTE) and by adding RNFTE to PARAFTE to create the new variable (RNTEKFTE). The first change was done because the inclusion of extended providers has been shown to improve productivity within the Air Force. [Ref. 44] These changes led to the same basic results. Also, because of the omission of relevant variables the results may be biased.

Table 12. RESULTS OF VARIATIONS TO BASIC REGRESSION MODEL

Model 4: DROPPED BOTH MAJTEACH AND RCMI

TOTVIS =	50,374	- 8730(OCCUP)	- 8241(ARMY)	+ 75653 (NAVY)	- 317(CLINFTE)
t =		-0.574	-4.742	3.367	-1.788

+ 1127(PROFTE)	+ 609(PARAFTE)	+ 88(RNFTE)	+ 4.8(ADMFTE)	
2.886	8.535	0.272	0.119	

Model 5: TRANSFORMED VARIABLES (DRPROFTE) AND (RNTEKFTE)

TOTVIS =	187871	- 6734(OCCUP)	- 104650(ARMY)	+ 56915(NAVY)	- 121664(RCMI)
t =		-0.427	-5.874	2.565	-2.618

+ 4938(MAJTEACH)	- 106(DRPROFTE)	+ 541(RNTEKFTE)	+ 48(ADMFTE)
0.184	0.773	10.392	1.165

2. Factor Analysis

Given these results, a factor analysis was conducted to determine the degree to which all the staffing variables represented a single underlying staffing variable. Factor analysis is a useful technique to examine the interrelationships among the five staffing variables. Factor analysis differs from principal component analysis in that the former examines interrelationships among variables while the latter has as its objective the selection of the principal

components that explain as much of the total variance as possible. In both cases there is no dependent variable. [Ref. 45] Rather, a set of variables, X_1, X_2, ..., X_p are standardized, so that their variances equal one and their covariances are correlation coefficients. Each variable is then represented as a linear combination of a smaller set of "common factors" as well as a factor unique to each of the standardized variables. Thus, the factor model is represented by: [Ref. 46]

$$x_1 = l_{11}F_1 + l_{12}F_2 + \ldots l_{1M}F_M + e_1$$

$$x_p = l_{p1}F_1 + l_{p2}F_2 + \ldots + l_{pM}F_M + e_p$$

where,

m = number of common factors
F_1, F_2, ..., F_M are the common factors
L_i is the coefficient of F_j
e_1, e_2, ..., e_p are unique factors

Breaking each response variable into two parts also breaks the variance into two parts - the variance due to the common factors (communality) and the variance due to the unique factor (specificity). Use of this procedure yielded the following four results, also indicated in Table 13. The numbers below correspond to the item numbers in the table.

1. Partial correlations are high between CLINFTE and RNFTE (.77), and PARAFTE and RNFTE (.62), and moderate between ADMFTE and PROFTE (.47).

2. Kaiser's Measure of Sampling Adequacy (MSA) is .84 overall, indicating an adequate sample. That is, the five staffing variables are sufficient to conduct the factor analysis. Values less than .5 indicates a need for additional variables while values equal to or greater than .8 are considered acceptable, as a general rule [Ref. 47]

3. The Eigenvalues are all less than one, except for the first principal component which has a value of 4.5. Values less than one are not used in the analysis. This means that 91 percent of the standardized variance is explained by only one principal component.

4. The factor pattern, involving two factors, shows that all five staffing variables have especially high positive loadings on the first principal component while the second component is a contrast of ADMFTE (.41) against RNFTE (-.17) and PARAFTE (-.23), with very small loadings on CLINFTE and PROFTE.

Table 13. RESULTS OF FACTOR ANALYSIS ON TWO PRINCIPAL COMPONENTS

Initial Factor Method: Principal Components

Partial Correlations Controlling all other Variables

1

	CLINFTE	PROFTE	RNFTE	PARAFTE	ADMFTE
CLINFTE	1.00000	0.18220	**0.77463**	-0.19966	0.23984
PROFTE	0.18220	1.00000	**-0.05410**	0.35023	**0.47017**
RNFTE	**0.77463**	-0.05410	1.00000	**0.62808**	-0.02302
PARAFTE	-0.19966	0.35023	**0.62808**	1.00000	-0.11659
ADMFTE	0.23984	**0.47017**	-0.02302	-0.11659	1.00000

Kaiser's Measure of Sampling Adequacy: **Over-all MSA = 0.83978694**

2

CLINFTE	PROFTE	RNFTE	PARAFTE	ADMFTE
0.818345	0.891772	0.768136	0.845260	0.903252

Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 5 Average = 1

3

	1	2	3	4	5
Eigenvalue	**4.5265**	0.2628	0.1149	0.0759	0.0200
Difference	4.2636	0.1480	0.0390	0.0559	
Proportion	0.9053	0.0526	0.0230	0.0152	0.0040
Cumulative	0.9053	0.9579	0.9808	0.9960	1.0000

2 factors will be retained by the NFACTOR criterion.

Factor Pattern

4

	FACTOR1	FACTOR2	
CLINFTE	**0.97305**	-0.07957	PHYSICIAN FTE
PROFTE	**0.95391**	0.08775	PROFESSIONAL FTE
RNFTE	**0.97438**	-0.16637	REGISTERED NURSE FTE
PARAFTE	**0.95174**	-0.22684	PARAPROFESSIONAL FTE
ADMFTE	**0.90248**	0.41189	ADMINISTRATIVE FTE

Variance explained by each factor

FACTOR 1	FACTOR 2
4.526454	0.262822

Final Communality Estimates: Total = 4.789277

CLINFTE	PROFTE	RNFTE	PARAFTE	ADMFTE
0.953168	0.917639	0.977088	0.957261	0.984122

These findings are presented graphically in Figures 8 and 9, both before and after factor rotation. Of interest is the linear relationship of the variables. There is not enough variability in the data to capture the separate effects of these variables. Instead, these findings suggest some sort of uniform pattern in staffing which could have several plausible explanations, including joint staffing methodology, inaccurate workload reporting methods, or the manner in which MEPRS aggregates the data during stepdown.

Although these findings could be used in the original model by substituting the first principal component for the five staffing variables little insight would be provided by doing so. Therefore, the only reasonable conclusion is that the aggregate data do not provide enough variability to meet the objectives of this research. However, these findings may not apply when viewed from the workcenter, the next topic of discussion.

C. REGRESSION RESULTS (WORKCENTER)

Given the primary care focus in Chapter 2, three primary care workcenters were selected for separate analysis. Although multicollinearity still exists within the workcenter data, it does not appear to be as severe as with the complete data set of all-CONUS hospitals. However, caution should be exercised in the interpretation of the results, presented in Table 14.

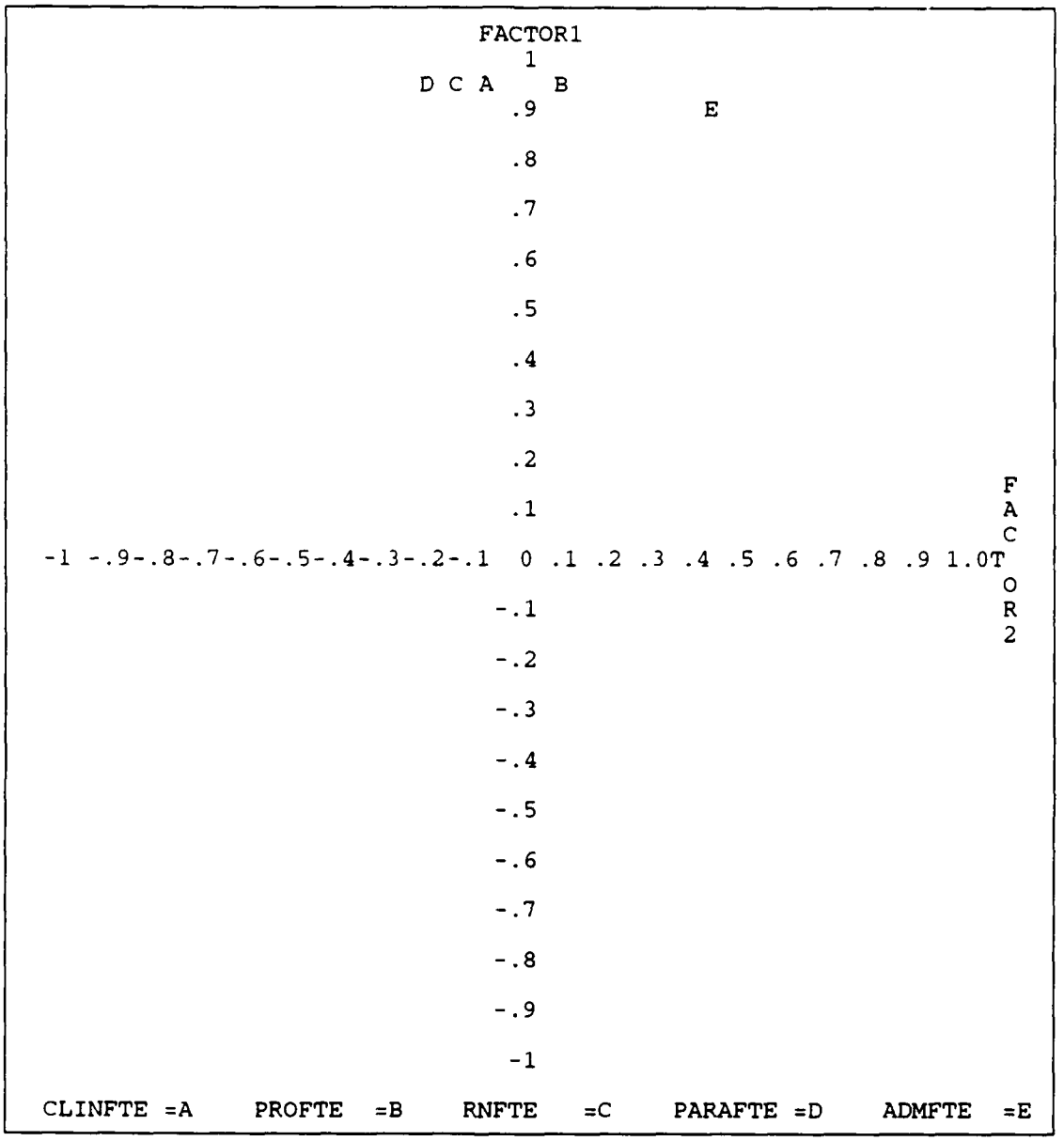

Figure 8. Unrotated Plot of Factor Pattern for FACTOR1 and FACTOR2

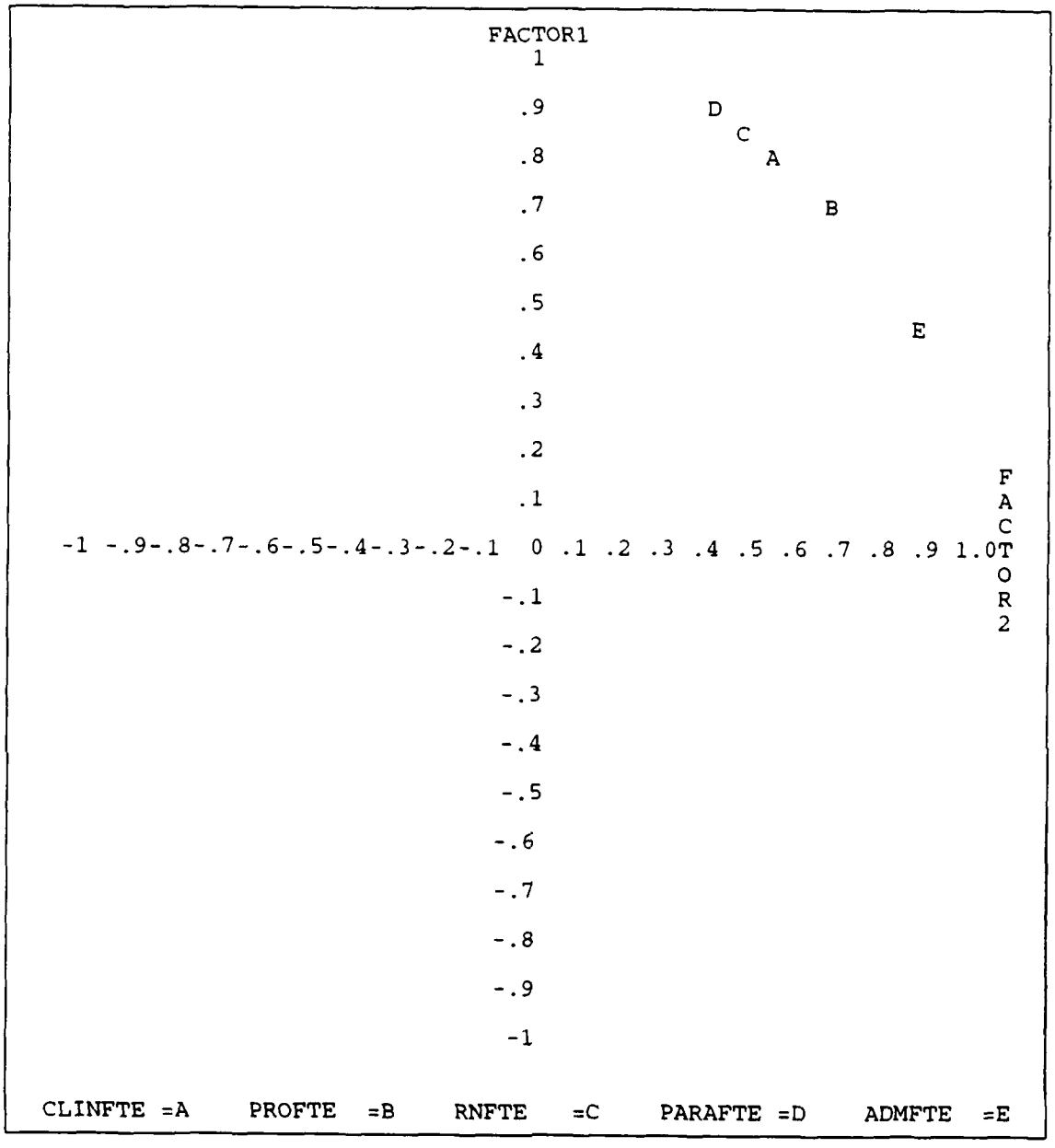

Figure 9. Rotated Plot of Factor Pattern for FACTOR1 and FACTOR2

1. Family Practice

Within the family practice workcenter, Navy is significant and positive, generating 10,824 more total annual

visits than Air Force. The significance of Navy might be explained by the increased visits in FY90 versus the declining

Table 14. ESTIMATED PRODUCTION FUNCTIONS, BY WORKCENTER
(t-statistic in parentheses)

Variable	Family Practice	Internal Medicine	Pediatrics
ARMY	-2543	878	-12452
	(-0.621)	(0.352)	(-2.876)*
NAVY	10824	7886	7731
	(2.874)*	(2.904)*	(1.632)
MAJTEACH	-3295	-6193	-13355
	(-0.836)	(-1.837)***	(-2.713)*
CLINFTE	1146	1624	0.0196
	(2.766)*	(4.561)*	(0.055)
PROFTE	3832	5439	3316
	(3.310)*	(2.973)*	(1.686)***
RNFTE	1515	1451	2578
	(1.118)	(1.002)	(1.352)
PARAFTE	1144	1595	1278
	(2.623)**	(2.015)**	(1.548)
ADMFTE	-965	-656	-1271
	(-1.441)	(-0.607)	(-0.830)
Adj R-square	.60	.46	.31
Sample Size (n=)	80	121	119

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

workload during the same period for Air Force. MAJTEACH was not significant, but negative, as expected and is consistent with the findings of Kearl and Mainous (1993). CLINFTE, PROFTE, and PARAFTE were all significant and positive as expected; however, increasing the professional group (PROFTE) by one FTE increases total visits by 3,822, more than twice that of adding one more clinician. Similar to the findings of Buchanan and Hosek (1983), this is possibly attributable to the use of increased physician extenders, physician assistants and nurse practitioners, for example, to offset physician

shortages. Finally, RNFTE and ADMFTE were not significant. Although the negative coefficient for ADMFTE was unexpected, the true effect of the administrative/clerical component could be masked by the inclusion of an indirect contribution (via MEPRS) of non-workcenter personnel. Another explanation could be that the administrative/clerical staff component is understaffed, though not sufficiently variable to make a measurable positive contribution. The adjusted R-square of .60 indicates that 60 percent of the variation has been explained by this functional relationship, which is a moderate fit, consistent with prior research (Pope and Hurdle).

2. Internal Medicine

Within the internal medicine workcenter, Navy is again significant and positive. MAJTEACH is significant, with a teaching hospital producing 6,192 fewer total annual visits than does a non-teaching hospital. CLINFTE, PROFTE, and PARAFTE are all significant and positively contribute to physician productivity. However, again the contribution of ADMFTE is negative, owing possibly to the same reasons previously discussed.

3. Pediatrics

Within this workcenter ARMY, is significant and produces 12,452 fewer total annual pediatric visits than Air Force. MAJTEACH is significant and negative. Surprisingly, CLINFTE is not significant whereas PROFTE is, at the 10 percent level. None of the remaining staffing

variables are significant. Given the relatively poor fit (adjusted R-square = .31), this model does not adequately explain the factors influencing total visits, hence physician productivity. This finding implies that the factors influencing productivity in one workcenter may differ from the factors that apply in another.

V. SUMMARY AND CONCLUSIONS

A. SUMMARY

This thesis evaluated the relationship between the administrative/clerical staff complement and physician productivity across military treatment facilities and Services, using aggregate MEPRS data for fiscal year 1990. Regrettably, this relationship cannot be established, using these data, despite all efforts to do so by using regression analysis. Regression analysis defines the functional relationship between a set of independent variables and a dependent variable. The dependent variable here total hospital visits (TOTVIS), represents physician productivities. Among the independent variables, the administrative/clerical staff variable is not significant while physician input (CLINFTE) is significant, but negative. Correlation among the five staffing variables was extremely high, however, indicating strong multicollinearity among these variables.

Factor analysis, useful for describing relationships among variables, was used to assess the five staffing variables. For the five, 91 percent of the variation could be explained using only one principal component, suggesting some sort of uniformed staffing pattern. Consequently, there is not sufficient variation between the administrative/clerical staff and other staff personnel to show a distinct effect of

administrative/clerical personnel on physician productivity in this study.

Within the workcenter, however, the results were more promising. Administrative/clerical staff is negative, but not significant which is inconsistent with the findings of Pope and Hurdle (1989). There is significant variation with NAVY, CLINFTE, PROFTE, and PARAFTE within the workcenter, however; the models presented provide only moderate explanatory power, indicating that other factors may be involved.

B. CONCLUSION

Although this effort did not produce the intended results, it does show that using aggregate MEPRS data will not allow adequate comparisons at the hospital level due to the lack of staffing variability. However, it does seem useful when examining the workcenter. Perhaps this is because MEPRS is a workcenter-based system. The advantage of using MEPRS data is its consistency. However, in the aggregate, the data does not readily lend itself to comparative analysis.

C. FUTURE STUDIES

Although this research does not yield the desired results, it does provide insight for future research. Other research opportunities include:

- Analysis of all workcenters, both inpatient and outpatient, to capture differences in physician productivity

and staffing.

- A cost benefit analysis, if financial data is available, comparing workcenter personnel direct costs against workcenter workload.
- Separation of actual physician patient contact time from time spent doing non-physician tasks to assess why physician contribution varies across workcenters.
- Estimation of the effect of actual workcenter staffing patterns on physician productivity, if actual staffing data is available (other than MEPRS).

While this list is not exhaustive, continued use of quantitative methods of analysis and economic theory should enhance the interpretation of results and allow manpower becomes more reliable and allow manpower planners to make more informed decisions regarding manpower policy. This effort becomes particularly important in a managed care environment.

APPENDIX A. GLOSSARY

Available Time - Assigned man-hours dedicated to performance of primary duties, plus time allowed for personal, fatigue, delay standby, and travel activity - computed by subtracting non-available hours from assigned hours.
Source: Joint Healthcare Manpower Standards (JHMS), Nov 89

Borrowed Labor - Man-months (1 FTE work-month = 168 hours). All productive work or service provided to the MTF by personnel other than permanently assigned personnel (those carried on staffing documents).
Source: Navy Health Care Planning Matrix (HCPM) FY91

Catchment Area - Defined by OASD(HA) as the five digit zip code zones whose geographic center lies within 40 miles of the center of the zip code zone in which the MTF is located.
Source: Navy HCPM FY91

Continuation Rates - Measures the percentage of medical officers on active at the beginning of the fiscal year (in question) who were still on active duty at the end of the fiscal year.
Source: CNA Report CRM 88-231/March 1989

Direct Care/Direct Care System - The direct health care system, the larger of the two parts of the military health care system (the other part being CHAMPUS), is made up of hospitals and clinics operated by the Army, Navy and Air Force. It includes 140 hospitals and 553 clinics worldwide and employees more than 54,000 civilians, as well as 146,000 active duty military personnel.
Source: CBO Testimony May 10, 1993

DoD Relative Case Mix Index - The adjustment factor for all case mix calculations. It is the average RWPs per disposition for DoD in FY95 and is equal to .8109.
Source: FY1989 Health Data Summary

End Strength - The number of personnel actually assigned as of the last day of the reporting period.
Source: JHMS

Fiscal Year - The 12 month accounting period used by the Federal Government (1 October to the next 30 September)
Source: JHMS

Fixed Medical Treatment Facility - An established land-based medical center, hospital, clinic, or other facility that provides medical, surgical, or dental care and that does not fall within the definition of a non-fixed medical treatment facility.
Source: JHMS

Full-Time Equivalent - Work force equivalent of one individual working full-time for a specific period, which may be made up of several part-time individuals or one full-time individual.
Source: JHMS

Graduate Medical Education (GME) - The years between undergraduate medical education and continuing medical education; it includes both residency and fellowship training.
Source: JHMS

Managing to payroll - Facility commander authority to hire the appropriate civilian staff as budget and needs allow.

Non-availability Statements - Authorization for patients within the catchment area to seek medical care from sources outside of the direct care system when said care is unavailable within the direct care system.

Non-available Time - Assigned man-hours allowed for participation in those activities directed, recognized and approved by the Services, which render the individual unavailable for assigned primary duties. These activities include official leave, Permanent Change of Station (PCS) activities, medical visits or treatments, and organizationally directed duties, such as charge or quarters, watch, parades and formations, and details. Also included is official release from active duty to participate in education and training and drug and alcohol rehabilitation, and other miscellaneous absences such as Absence Without Official leave (AWOL) or desertion, and release from duty for civic duties, such as voting or jury duty.
Source: JHMS

Occupancy rate - Average daily patient load (no patients) divided by the number of operating beds.

Operating beds - The number of beds for which staffing and resources are available to deliver care.

Outpatient visits - Reported for each outpatient who presents him/herself at an MTF for medical advice, diagnosis,

treatment, or complete physical examination, or one who is treated or observed in his/her home or quarters by medical personnel.
Source: Navy HCPM FY91

Primary Care Provider - Physicians, physician extenders and other professionals who manage the total care for individual patient. For example, General Medical Officers, Pediatricians, Physician Assistants, Nurse Practitioners.

Retention Rates - Measures calculated based on actual population on board during specified period of time.
Source: CNA Report, CRM 88-231/March 1989

Relative Weighted Product (RWP) - The weight assigned to biometrics dispositions based on methodology documented in MHSS DRG Based Recourse Allocation Guidance.
Source: FY89 Health Data Summary

Staffing:

a. Clinicians - Physician or dentist practitioners with admitting privileges and primary responsibility for patient care. Includes interns and residents.

b. Registered Nurse - One who is a graduate of a school of nursing, is registered to practice, has a valid license and is legally entitled to use the designator RN.

c. Direct Care Professionals - Optometrists, podiatrists, nurse practitioners, physician's assistants, and other non-physician health care professionals.

d. Direct Care Paraprofessionals - Paraprofessionals involved in the direct care of patients such as LPNs, hospital corpsmen, and dental technicians.

e. Administrative/clerical/logistical - Personnel of all ranks rates, and otherwise not classified.
Source: Navy HCPM FY91

APPENDIX B. JOINT HEALTHCARE MANPOWER STANDARDS (JHMS)

1. Type I standards, also called engineered standards, are quantitative in nature and have demonstrated statistical soundness through regression analysis.

2. Type II and Type III standards are used when the work performed is not applicable to engineered methods. Type II standards are those for which the statistical standards for Type I classification do not hold. Generally, the man-hours are derived by use of the operational audit. Type III standards differ from Type II standards in terms of the work method and analysis procedures. In some work centers, the tasks performed are not as easily measured using regression analysis. In these cases, workload is estimated using historical data, staffing patterns, simulation or other less precise methods.

3. A Manpower Guide classification is assigned to a manpower model that adequately describes the relationship between required resources and mission workload. A guide is used in situations where work center size, changes in systems, policies or procedures make the establishment of an engineered standard too costly or in cases where a previously engineered standard no longer applies, but can be used as a guide.

DATA SOURCE AND STATISTICAL REQUIREMENTS TABLE

STEP	A Standards Classified as	B Which are based on work measurement method	C Must meet requirements	D Result in a standard equation with statistical parameters (see Note 1)
1	Type I (see Note 2)	Work Sampling	- 3% absolute accuracy - 95% confidence level - complete work cycle sampled - minimum number of input location used - at least 15 usable sampling days	Regression analysis used to obtain equation and $R^2 \geq .750$ $V \leq 150$ $Fc \geq F_{.95,\ m-1,\ n-m}$ (not applicable if $n \leq 5$) For parabola $tc \geq t_{.90,\ n-1}$ For multivariate $tc \geq t_{90,\ n-1}$
2		Time Study	- 10% relative accuracy - 95% confidence level - minimum number of input locations used	
3	Type II	Work Sampling	- 3% absolute accuracy - 95% confidence level - complete work cycle sampled - at least 15 usable days - minimum number of input locations used	Regression analysis used to obtain equation and $R^2 \geq .500$ $V \leq .250$ $FC \geq F_{90,\ m-1,\ n-m}$ (not applicable if $n \leq 5$) For parabola $tc \geq t_{90,\ n-1}$ for multivariate $t_{bi} \geq t_{.90,\ n-1}$
4		Time Study	-15% relative accuracy - 95% confidence level - minimum number of input locations used	
5		Operational Audit	- minimum number of locations used	

TABLE CONTINUED

STEP	A	B	C	D
	Standards Classified as	**Which are based on work measurement method**	**Must meet requirements**	**Result in a standard equation with statistical parameters (see Note 1)**
6	Type III	Work Sampling Time Study, Operational Audit	- minimum number of locations used	Regression analysis used to obtain equation and $R^2 \geq .500$ Equation must still meet both the realistic and the economic criteria.
7		Staffing Pattern, Directed Requirement, Minimum Manpower Factors, Functional Model, Historical Data. Single, Location and Small Population Standards	Based on logical rationale used to support to support the applicability of the development method as most appropriate for the work center. Must follow the constraints specified by regulation.	
8	Manpower Guide	The minimum level of study design, measurement, and statistical criteria which satisfactorily describes relationships between required resources and mission workload.		

NOTES:

1. A standard represents a work center's man-hour requirements in response to varying levels of workload. Therefore, an equation that consists only of a constant will not be classified unless it was determined with staffing pattern, directed requirement, or minimum manpower factors.

2. To be classified as a Type I standard, at least 80% of the man-hours must be based on the use of work sampling, time study, standard time data, or a combination of these engineered methods.

APPENDIX C. MEDICAL EXPENSE AND PERFORMANCE REPORTING SYSTEM (MEPRS)

The Medical Expense and Reporting System (MEPRS) was formally established in 1986 to provide consistent principles, standards, policies, definitions, and requirements for accounting and reporting of expense, manpower and performance by DoD fixed military medical facilities [Ref.11:p.1-8]. It applies to all Army, Navy and Air Force fixed MTFs and is the only source within DoD for tracking healthcare cost and workload data. Like the JHMS, MEPRS does not apply to DoD Components not involved in direct patient care or those that are non-fixed such as field support or medical facilities afloat.

The MEPRS classifies hospital services into six broad functional areas: inpatient care, outpatient (ambulatory) care, dental care, ancillary services, support services and special programs. Within each of these broad groupings, it further classifies functions by work center - where services are rendered and where workload and expenses are ultimately assigned.

Although all expenses are eventually assigned into one of the four final accounts (inpatient care, outpatient care, dental care and special programs), MEPRS maintains

intermediate accounts for ancillary and support services whose costs must be distributed among work centers. In addition, for those costs which cannot be easily identified, local MTFs establish cost pools which serve as holding accounts until final allocations are made. Where costs are not directly assigned to the work center as is the case with ancillary and support services, they are allocated based on established performance factors.

The collection of all manpower data begins at the MTF work center level. On a daily basis all work hours are recorded by the work center supervisor which includes work performed by personnel (military and civilian) who are assigned, detailed, contracted, borrowed and those who volunteer. A further distinction is made between time that an individual was not available to contribute to the work center. This non-available time is not included the expense portion of MEPRS. Based on the assumption that each person works an average of 168 hours per month, all work hours are expressed in terms of its Full-time Equivalent (FTE) ratio.

APPENDIX D. REGRESSION RESULTS

MODEL 2: DROPPED MAJTEACH
Dependent Variable: TOTVIS

Root MSE	67215.07861	R-square	0.9297
Dep Mean	291657.02459	Adj R-sq	**0.9240**
C.V.	23.04593		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	140149	51072.507002	2.744	0.0071
OCCUP	1	-8815.087785	14911.610055	-0.591	0.5556
ARMY	1	-86263	17104.956999	-5.043	0.0001*
NAVY	1	72179	22059.268588	3.272	0.0014*
RCMI	1	-106044	44363.712117	-2.390	0.0185**
CLINFTE	**1**	**-302.423659**	**173.96929924**	**-1.738**	**0.0849****
PROFTE	1	1203.351015	384.07905674	3.133	0.0022*
RNFTE	1	364.078181	335.88872660	1.084	0.2807
PARAFTE	1	553.230744	73.69299681	7.507	0.0001*
ADMFTE	**1**	**14.599098**	**39.62885946**	**0.368**	**0.7133**

Variable	DF	Variance Inflation	Variable Label
INTERCEP	1	0.00000000	Intercept
OCCUP	1	1.03956196	OCCUPANCY RATE
ARMY	1	1.61635972	US ARMY FIXED MEDICAL FACILITIES
NAVY	1	2.01025891	US NAVY FIXED MEDICAL FACILITIES
RCMI	1	3.04511375	DOD ADJUSTED CASE MIX INDEX
CLINFTE	**1**	**22.94104982**	**PHYSICIAN FULLTIME EQUIVALENTS**
PROFTE	**1**	**8.26643970**	**PROFESSIONAL FULLTIME EQUIVALENTS**
RNFTE	**1**	**35.86657671**	**REGISTERED NURSE FULLTIME EQUIVALENT**
PARAFTE	**1**	**19.28234707**	**PARAPROFESSIONAL FULLTIME EQUIVALENT**
ADMFTE	**1**	**5.02983357**	**ADMINISTRATIVE FULLTIME EQUIVALENT**

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

MODEL 3: DROPPED RCMI
Dependent Variable: TOTVIS

Root MSE	68821.71478	R-square	0.9263
Dep Mean	291657.02459	Adj R-sq	**0.9203**
C.V.	23.59680		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	34640	46196.374663	0.750	0.4549
OCCUP	1	-8204.212492	15300.043714	-0.536	0.5929
ARMY	1	-80572	17776.660422	-4.532	0.0001*
NAVY	1	75693	22537.617224	3.359	0.0011*
MAJTEACH	1	13215	24894.027542	0.531	0.5966
CLINFTE	1	-312.586047	178.22801641	-1.754	0.0822**
PROFTE	**1**	**1119.344964**	**392.20650134**	**2.854**	**0.0051***
RNFTE	1	120.899371	328.91657053	0.368	0.7139
PARAFTE	1	608.652191	71.57974838	8.503	0.0001*
ADMFTE	**1**	**6.017129**	**40.42335280**	**0.149**	**0.8819**

Variable	DF	Variance Inflation	Variable Label
INTERCEP	1	0.00000000	Intercept
OCCUP	1	1.04392450	OCCUPANCY RATE
ARMY	1	1.66524002	US ARMY FIXED MEDICAL FACILITIES
NAVY	1	2.00155818	US NAVY FIXED MEDICAL FACILITIES
MAJTEACH	1	2.60070603	REFER CENTER MORE THAN 1 RESIDENCY
CLINFTE	**1**	**22.96690373**	**PHYSICIAN FULLTIME EQUIVALENTS**
PROFTE	**1**	**8.22222333**	**PROFESSIONAL FULLTIME EQUIVALENTS**
RNFTE	**1**	**32.80598041**	**REGISTERED NURSE FULLTIME EQUIVALENT**
PARAFTE	**1**	**17.35282701**	**PARAPROFESSIONAL FULLTIME EQUIVALENT**
ADMFTE	1	4.99203447	ADMINISTRATIVE FULLTIME EQUIVALENT

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

MODEL 4: DROPPED BOTH MAJTEACH AND RCMI
Dependent Variable: TOTVIS

Root MSE	68602.66434	R-square	0.9261
Dep Mean	291657.02459	Adj R-sq	**0.9209**
C.V.	23.52169		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	50374	35324.012005	1.426	0.1566
OCCUP	1	-8729.634393	15219.401073	-0.574	0.5674
ARMY	1	-82411	17380.401917	-4.742	0.0001*
NAVY	1	75653	22465.754917	3.367	0.0010*
CLINFTE	**1**	**-317.210230**	**177.44842900**	**-1.788**	**0.0765*** **
PROFTE	1	1127.411588	390.66463088	2.886	0.0047*
PARAFTE	1	608.970691	71.34941306	8.535	0.0001*
RNFTE	1	87.615692	321.85799374	0.272	0.7860
ADMFTE	**1**	**4.802142**	**40.23005397**	**0.119**	**0.9052**

Variable	DF	Variance Inflation	Variable Label
INTERCEP	1	0.00000000	Intercept
OCCUP	1	1.03955599	OCCUPANCY RATE
ARMY	1	1.60200966	US ARMY FIXED MEDICAL FACILITIES
NAVY	1	2.00153536	US NAVY FIXED MEDICAL FACILITIES
CLINFTE	**1**	**22.91204394**	**PHYSICIAN FULLTIME EQUIVALENTS**
PROFTE	**1**	**8.20988158**	**PROFESSIONAL FULLTIME EQUIVALENTS**
PARAFTE	**1**	**17.35160791**	**PARAPROFESSIONAL FULLTIME EQUIVALENT**
RNFTE	**1**	**31.61397659**	**REGISTERED NURSE FULLTIME EQUIVALENT**
ADMFTE	1	4.97603189	ADMINISTRATIVE FULLTIME EQUIVALENT

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

MODEL 5: TRANSFORMED VARIABLES (DRPROFTE)
Dependent Variable: TOTVIS

Root MSE	71010.67007	R-square	0.9208
Dep Mean	291657.02459	Adj R-sq	**0.9152**
C.V.	24.34732		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	187871	66970.026797	2.805	0.0059
OCCUP	1	-6733.591161	15777.870308	-0.427	0.6704
ARMY	1	-104650	17815.833105	-5.874	0.0001*
NAVY	1	56915	22185.708436	2.565	0.0116**
RCMI	1	-121664	46477.588370	-2.618	0.0101**
MAJTEACH	1	4937.922685	26786.096466	0.184	0.8541
DRPROFTE	**1**	**-105.734297**	**136.69815814**	**-0.773**	**0.4408**
RNTEKFTE	**1**	**540.774004**	**52.03979188**	**10.392**	**0.0001***
ADMFTE	**1**	**47.537753**	**40.78837208**	**1.165**	**0.2463**

Variable	DF	Variance Inflation	Variable Label
INTERCEP	1	0.00000000	Intercept
OCCUP	1	1.04275977	OCCUPANCY RATE
ARMY	1	1.57105908	US ARMY FIXED MEDICAL FACILITIES
NAVY	1	1.82180790	US NAVY FIXED MEDICAL FACILITIES
RCMI	1	2.99447805	DOD ADJUSTED CASE MIX INDEX
MAJTEACH	1	2.82828746	REFER CENTER MORE THAN 1 RESIDENCY
DRPROFTE	**1**	**19.81804856**	COMBINED CLINFTE AND PROFTE
RNTEKFTE	**1**	**14.27843545**	**COMBINED RNFTE AND PARAFTE**
ADMFTE	**1**	**4.77407693**	**ADMINISTRATIVE FULLTIME EQUIVALENT**

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

MODEL 6: TRANSFORMED VARIABLES INTO OUTPUT RATIOS
Dependent Variable: TOTVIS

Root MSE	105965.61336	R-square	0.8268
Dep Mean	291657.02459	Adj R-sq	**0.8112**
C.V.	36.33227		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	529757	108426.26151	4.886	0.0001
OCCUP	1	4722.569004	23533.422161	0.201	0.8413
ARMY	1	-165593	26314.461728	-6.293	0.0001*
NAVY	1	-75395	44477.680015	-1.695	0.0929***
RCMI	1	-180928	72086.896160	-2.510	0.0135**
MAJTEACH	1	-67242	43233.103348	-1.555	0.1227
CLINFTE	**1**	**1222.150490**	**121.08200315**	**10.094**	**0.0001***
PROOUT	1	54180	48381.798800	1.120	0.2652
PARAOUT	1	5876.252590	12059.292405	0.487	0.6270
RNOUT	1	-1296.990180	49274.135539	-0.026	0.9790
ADMOUT	**1**	**-10794**	**8729.2135081**	**-1.237**	**0.2189**

Variable	DF	Variance Inflation	Variable Label
INTERCEP	1	0.00000000	Intercept
OCCUP	1	1.04177753	OCCUPANCY RATE
ARMY	1	1.53916981	US ARMY FIXED MEDICAL FACILITIES
NAVY	1	3.28819481	US NAVY FIXED MEDICAL FACILITIES
RCMI	1	3.23492283	DOD ADJUSTED CASE MIX INDEX
MAJTEACH	1	3.30868042	REFER CENTER MORE THAN 1 RESIDENCY
CLINFTE	1	4.47126864	PHYSICIAN FULLTIME EQUIVALENTS
PROOUT	1	1.62875428	PROFESSIONAL FTE PER CLINICIAN FTE
PARAOUT	1	4.98794066	TECHNICIAN FTE PER CLINICIAN FTE
RNOUT	1	2.26210695	REGIS NURSE FTE PER CLINICIAN FTE
ADMOUT	1	1.74945712	ADMIN FTE PER CLINICIAN FTE

* Significant at 1 percent
** Significant at 5 percent
*** Significant at 10 percent

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